CHAPTER 3

EXISTING SEWERAGE SYSTEM IN SOUTH DHAKA

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3.1 Overall Sewerage System

The sewerage system of Dhaka City was established in 1923 by the colonial English government. At that time, only the sewer system, the Narinda Pump Station (hereinafter referred to as a P/S) and a sewage treatment plant using the Imhoff tank method were constructed and up to the 1940's, the sewerage project served only Old Dhaka, namely South Dhaka. The Water Supply and Sewerage Master Plan was formulated in 1950's to cope with the population growth in Dhaka City and DWASA was established in 1963 as the exclusive implementing agency for those public works. The proposed DWASA organisation chart is shown in Figure 3.1.1.

The existing sewerage system is concentrated in South Dhaka. The water supply and sewerage service area, containing North and South Dhaka (Tongi is excluded), is divided into six zones. These zones are managed by a MODS (Maintenance Operation Distribution Service) Zone Office. The six MODS zones are shown in Figure 3.1.2.

The outline of the existing sewerage system is described below.

Table 3.1.1 Outline of Existing Sewerage System

Item	Existing Quantity	Remarks
Sewer Line	624 km (531 km)	(93 km) of sewer line in Zone IV for Small-Bore System in not yet operated since the discharge pump station is not yet completed
Sewer Pump Station	1 No.	Narinda
Sewer Lift Station	19 Nos.	Bashaboo, Sayedabad, Faridabad, Azimpur, Nawabganj, Hazaribag, Asad Gate, New Market, Tejgaon, Banani, Mohakhali, Mogbazar, P & T, Medical College, Mothertek, Goran, and other three locations
Sewage Treatment Plant	1 No.	Pagla

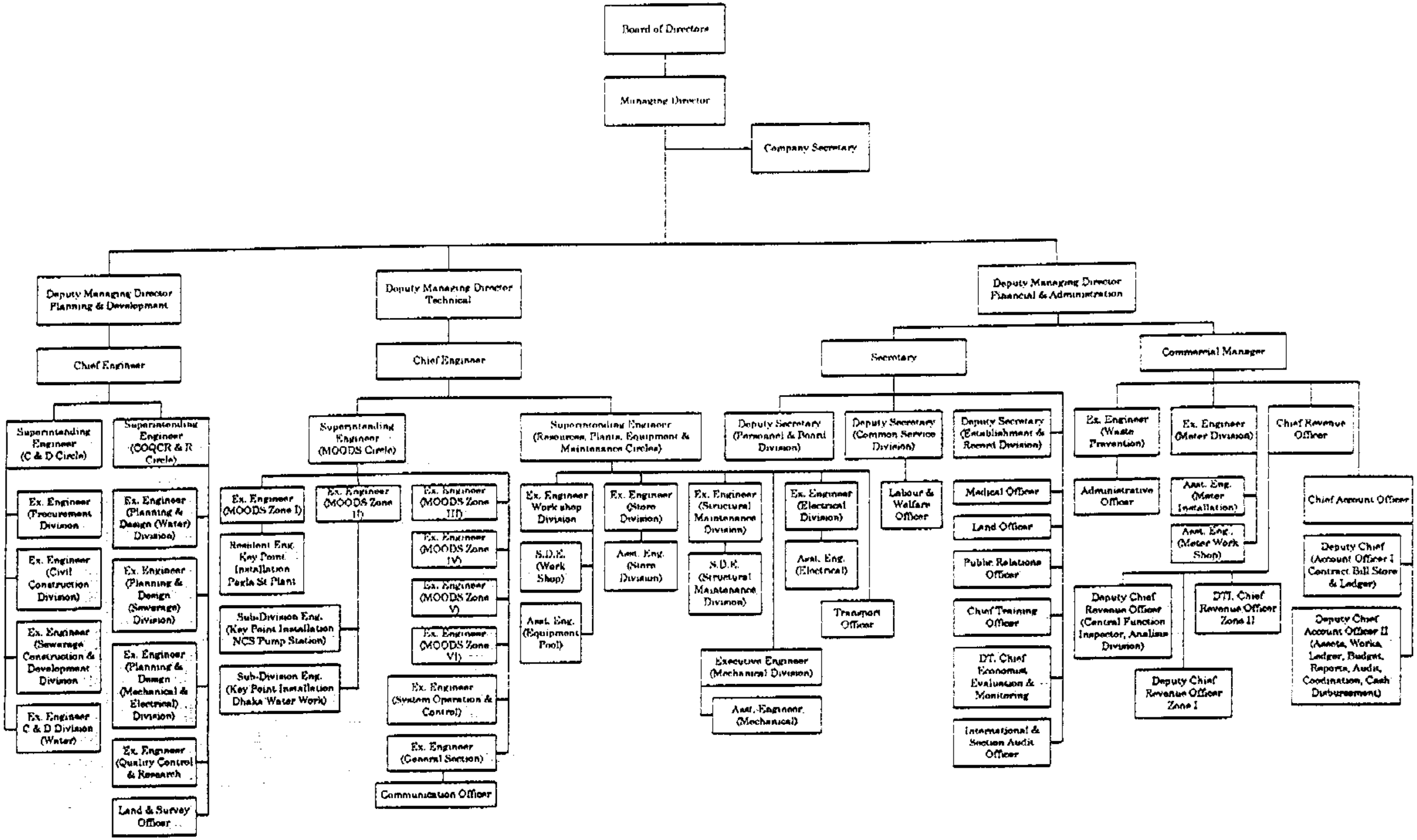


Figure 3.1.1
Proposed Organization Chart of DWASA

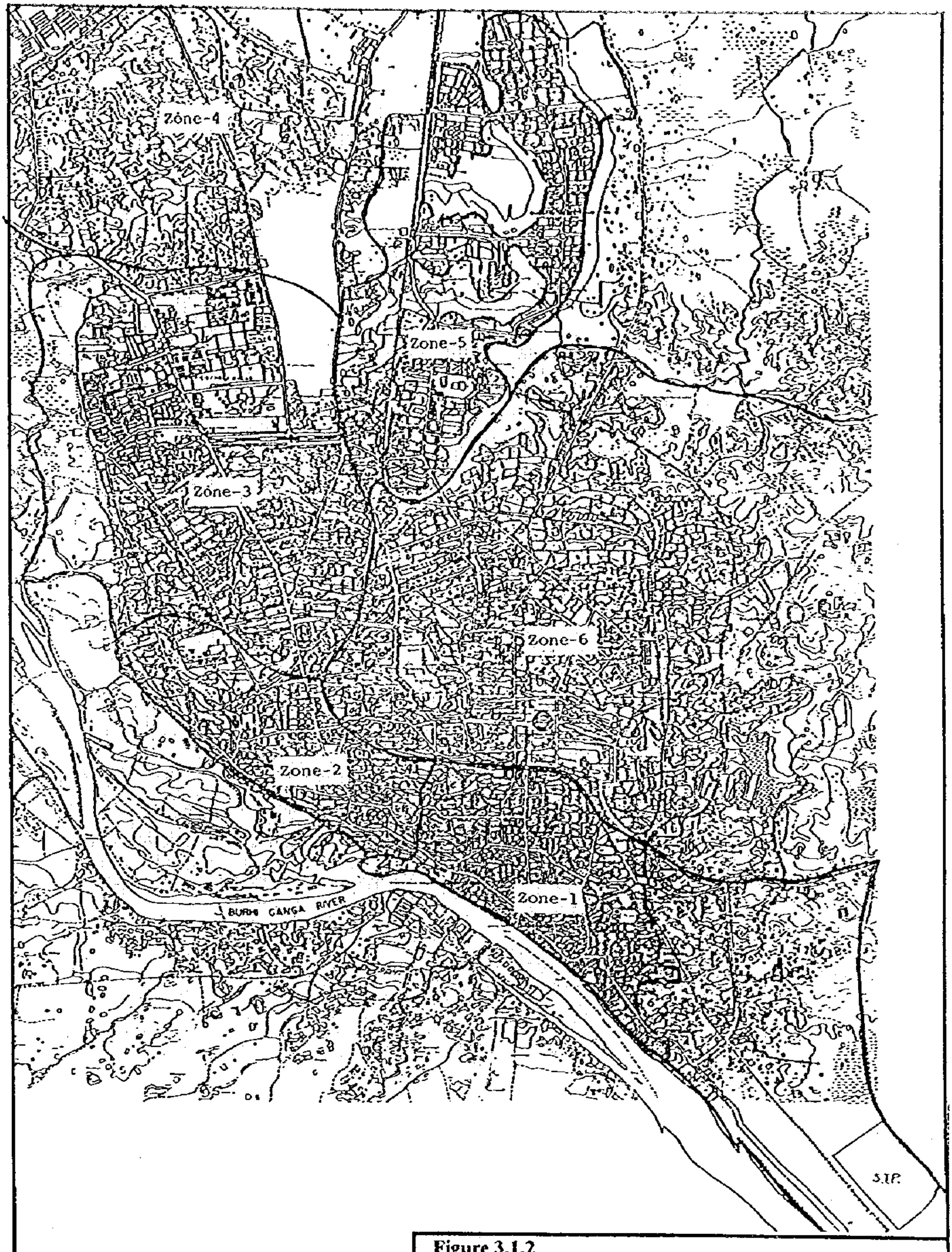


Figure 3.1.2

Water Supply And Swerage System Zoning

The Study on the Sewerage System in North Dhaka

3.2 Sewer System

3.2.1 Physical Condition

The sewer system is maintained by the MODS Zone Offices. The outline of the existing sewers in the six zones is summarised in Table 3.2.1.

Table 3.2.1 Outline of Existing Sewers in Six Zones

Zone	Total Length of Sewer	Present Status	Remarks
I	200 - 1,350mm L =150 km	Bad - 20 km	Needs repair
II	150 - 600mm L =110 km	Bad - 2.4 km	Needs repair
III	200 - 450mm L = 90 km	Bad - 3 km	Needs repair, Planned new sewer installation L = 15 km
IV	(L= 93 km)	-	Small-Bore System is not yet in operation
V	200 - 900mm L = 61 km	Good	
VI	150 - 900mm L =120 km	Bad - 10 km	Needs repair
Total	L= 624 km *(531 km)	Bad - 35.4 km	

Note: *excluding Zone IV

Materials for sewer lines are VC Pipe (Vitrified Clay Pipe), RC Pipe (Reinforced Concrete Pipe) and PVC Pipe (Polyvinyl Chloride Pipe) etc. Some sewer lines were constructed in early 1960's targeting the population of approximately 500,000 and are experiencing capacity shortages due to the rapid population growth in the city. Thus, not only repair work, but also new pipe installation to expand the sewer system capacity is also needed.

3.2.2 Practice of Operation and Maintenance

The sewers are mainly maintained by sewer inspectors, sewer mechanics and sewer cleaners. If citizens complain of any nuisance, for example flooding, sewage leakage, etc. to the complaint attendant of a Zone Office, a sewer inspector is dispatched to the problem site and, under his supervision, sewer mechanics and cleaners remove any sediments using hand-tools such as bamboo sticks. Sludge dewatering pumps and hydraulic jetting machines are also available. For detailed information of the existing O&M equipment in each Zone Office, please refer to Appendix 3.2.1.

Aside from the above-mentioned emergency claims, an annual cleaning program is formulated every year and routine cleaning is also carried out by cleaning teams. An organisation chart for each Zone Office is shown in Appendix 3.2.2.

However, the public opinion regarding sewerage and dust is usually low and some are disposing their wastes into sewers through manholes, which consequently causes clogging and flooding. In addition, manhole covers, mainly made of cast iron, are lost by theft and piled wastes beside the road flows into the open manholes on rainy days. Accordingly, public sanitation education is indispensable together with the replacement of the manhole covers.

Table 3.2.2 shows the number of O & M staff per one km of sewer in the six MODS Zones. O&M staff include sewer inspectors, sewer cleaners and vacuum operators.

Table 3.2.2 Number of O & M Staff per 1 km of Sewer

Zone	Total Length of Sewer	Number of O & M Staff	Staff per 1 km of Sewer
I	150 km	47	0.31
II	110 km	43	0.39
III	90 km	25	0.28
IV	(93 km)	(5)	(0.05)
V	61 km	25	0.41
VI	120 km	30	0.25
		Average	0.32

Although all zone offices are requesting more O&M manpower, compared with the average number, Zone I, III, IV are still below the average level. In addition, they are requiring O&M vehicles such as pick-up trucks, motorcycles, Tempo, etc. as well. For details, please refer to Appendix 3.2.1.

3.3 Lift and Pump Stations

3.3.1 Physical Condition

There are 19 Lift Stations (hereinafter referred to as L/Ss) and one P/S in South Dhaka. Their locations are shown is Figure 3.3.1. Under the last "Construction and Rehabilitation Project for the Sewerage of Dhaka City/JICA," 12 L/Ss and one P/S were rehabilitated. Their present status is summarised in Table 3.3.1. For detailed information, please refer to Appendix3.3.1. Three small L/Ss out of 19 L/Ss are not referred herein.

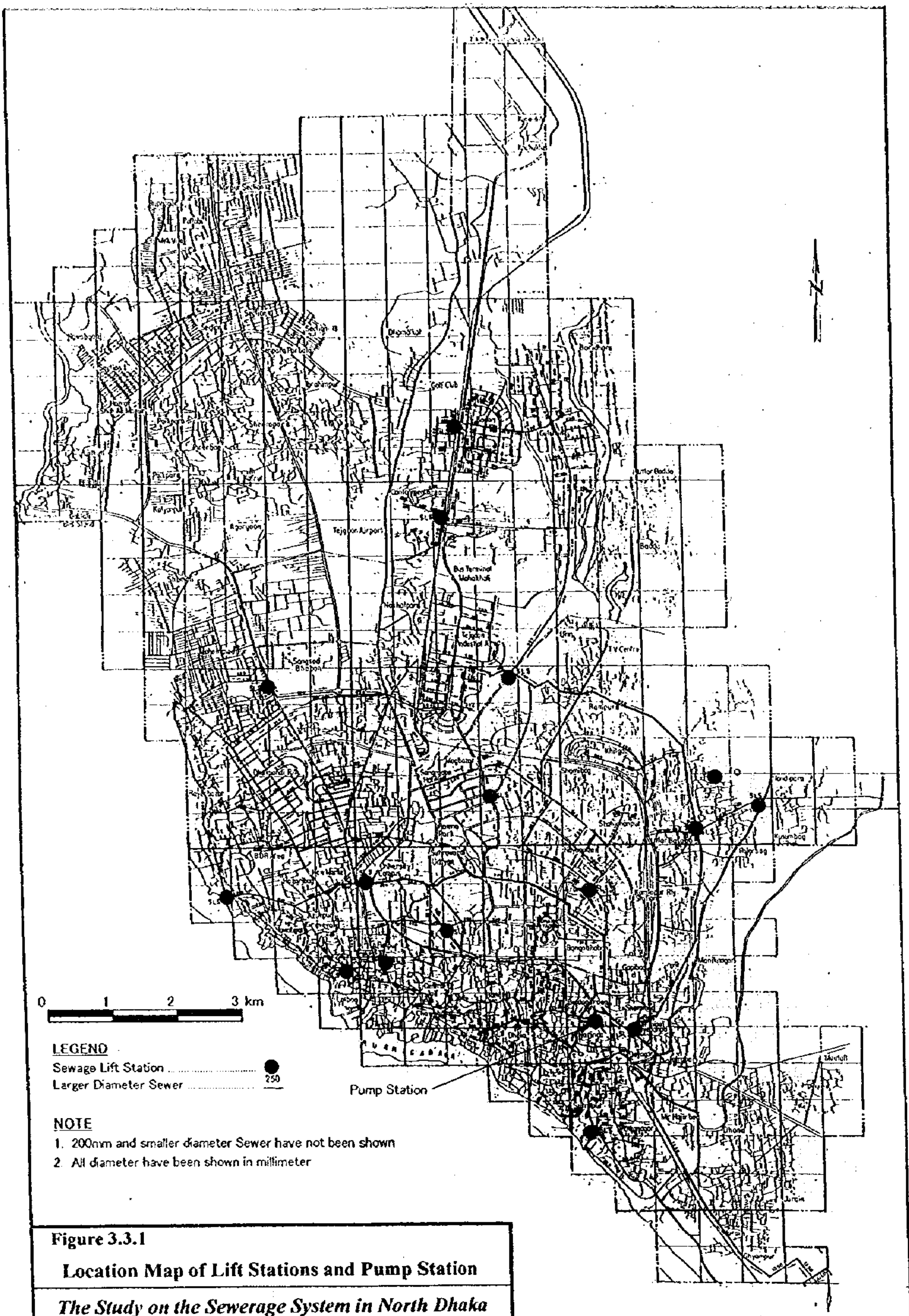


Figure 3.3.1

Location Map of Lift Stations and Pump Station

The Study on the Sewerage System in North Dhaka

Table 3.3.1 Present Status of Lift Stations and Pump Station

Zone	Name of Stations	Present Status
I	Narinda P/S (Old)	All six pumps are operational Vacuum pump should be repaired Not Operated due to the small incoming flow
	Narinda P/S (New)	Among seven pumps, five are operational Two pumps are under repair (impeller worn out, bearing damage) Vacuum pump should be repaired
	Bashaboo L/S	All five pumps are operational but one starter's magnetic contactor was burnt due to the voltage fluctuation Vacuum pump should be repaired Generator was burnt last July, 1993 due to short circuit
	Sayedabad L/S	All five pumps are operational Vacuum pump should be repaired
	Faridabad L/S	All two pumps are operational Battery for the generator should be recharged
II	Azimpur L/S	All two pumps are operational
	Nawabganj L/S	Among two, one pump was burnt on April, 1997 Battery of generator was damaged
	Hazaribag L/S	Last November, 1996, electricity was shut-down de to the damage of double fuse insulator and L/S is not operated The tannery's wastewater discharged into the pond nearby causing odour problems
III	Asad Gate L/S	Among three, one pump is under repair Vacuum pump should be repaired
	New Market L/S	Among four pumps, two are non-functioning due to shaft worn out Vacuum pump should be repaired
V	Tejgaon L/S	All five pumps are operational Vacuum pump should be repaired Seldom operated, since by-pass gate is open to allow the incoming sewage flow through by gravity
	Banani L/S	Running
	Mohakhali L/S	Among three pumps, No.2 pump is under repair (motor was burnt last 15 Jan., 1997)
VI	Mogbazar L/S	Among two sets of pump and starter, one set was burnt Battery of generator was damaged
	P & T L/S	All two pumps are operational
	Medical College L/S	All three pumps are operational but starter of No.1 pump is malfunctioning since the magnetic contactor was burnt
	Mothertek L/S	Running
	Goran L/S	Running

The existing facilities are generally in operational condition, however, malfunctioning facilities should be repaired immediately especially the pumps, starters, generators and electricity supply.

Further, the pumps are operated manually and the operating sewage level, the pump starting level, is inordinately high. This was observed at almost every L/S and P/S. This is because many of the water level indicators installed in wet wells were out-of-order and operators started the pumps only by their eye measurement of the sewage level in wet well. This might have hindered the smooth flow of sewage in upstream of the L/Ss and P/S. Thus, the water level indicator should be repaired immediately or some other measuring devices should be prepared.

3.3.2 Practice of Operation and Maintenance

These L/Ss and P/S are operated by pump operators in three shifts. The duty time of each shift is as follows:

Shift 1 : 6:00 - 14:00
Shift 2 : 14:00 - 22:00
Shift 3 : 22:00 - 6:00

Operational activities are recorded in a logbook and it contains, pump operation duration, voltage, current and countermeasures taken in accidents, such as breakdown, malfunctioning, current shut down etc. Since L/Ss are not equipped with any telecommunication system, operator must inform an officer in Zone Office in a case of accidents and that officer calls the maintenance team in the Narinda P/S. The composition of the maintenance team is as follows:

Table 3.3.2 Staff Composition of Maintenance Team in the Narinda Pump Station

Position	No.	Position	No.
Assistant Engineer	1	Wireless Operator	1
Sub-assistant Engineer	1	Driver	1
Foreman	1	Helper	4
Mechanic	1	Sewer Cleaner	1
		Total	11

Sewer cleaners on each Zone Office periodically remove the screenings once or twice a week and a test run of the generator is also conducted by the generator operator of the Zone Office.

3.3.3 Incoming Sewage Flow

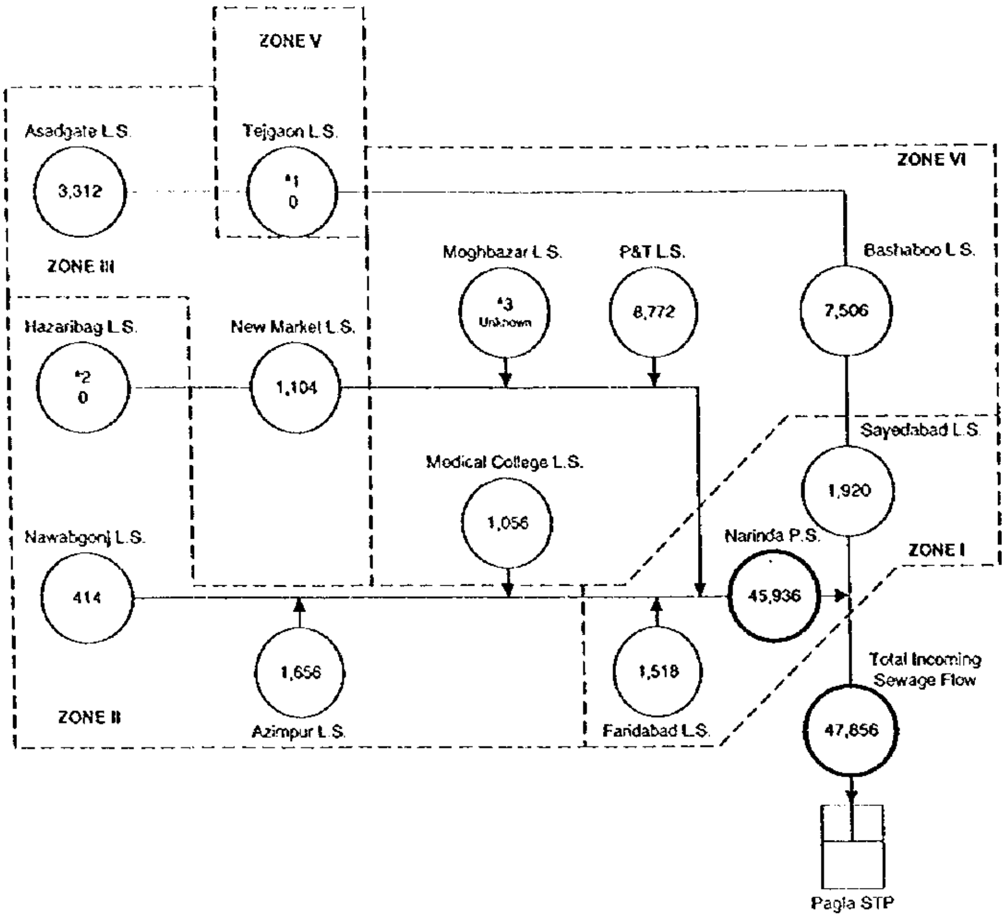
Incoming sewage flow for each L/S and P/S was calculated by the pump operation time and the results are shown in Table 3.3.3.

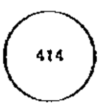
Table 3.3.3 Incoming Sewage Flow to Lift Stations and Pump Stations

Zone	Name of Station	Sewage Flow (cu.m /day)	Remarks
I	Narinda P/S (Old)	0	Not operated due to small incoming swage
	Narinda P/S (New)	45,936	Only No.1 pump is operated
	Bashaboo L/S	7,506	No.1, 2, 4, 5 pumps are operated
	Sayedabad L/S	1,920	No.4, 5 pumps are operated
	Faridabad L/S	1,518	No.1, 2 pumps are operated
II	Azimpur L/S	1,656	No.1, 2 pumps are operated
	Nawabganj L/S	414	No.2 pump is operated
	Hazaribag L/S	0	Not operated due to the electricity shut-down
III	Asad Gate L/S	3,312	No.1, 2 pumps are operated
	New Market L/S	1,104	No.3 pump is operated
V	Tejgaon L/S	0	By-pass gate is open and seldom operated
VI	Mogbazar L/S	Unknown	No record
	P & T L/S	8,772	No.1, 2 pumps are operated
	Medical College L/S	1,056	No.2, 3 pumps are operated

Figure 3.3.2 shows the schematic plan for L/S, P/S and STP.

Comparing the discharged flow from Bashaboo (7,506 cu.m/day) and Sayedabad (1,920 cu.m/day), which are located along the same trunk sewer, a large volume of sewage (5,586 cu.m/day) is missing. The trunk sewer was constructed in the early 1960's in a low, open area, not along to a road, and some portion seem to be broken due to the differential settlement of the ground. Accordingly, the missing volume can be assumed to be leakage from the breakage of the trunk sewer. The leaked sewage could overflow to the canals or channels nearby or be absorbed into the ground. This would cause serious surface/ground water or soil contamination. Immediate rehabilitation of the said trunk sewer is needed.



LEGEND:  414 m³/day: lifting/pumping sewage flow

NOTE:
*1 Seldom Operated--sewage flows through by a bypass route
*2 Not Operated--sewage flows through by a bypass route
*3 No Data Available

Figure 3.3.2
Schematic Plan for Lift Stations and Pump Station and Pagla STP

3.4 Sewerage Treatment Plant

3.4.1 Physical Condition

The Pagla STP was rehabilitated under a Japanese Grant Aid Project. The outline of the facilities are shown in Table 3.4.1 and the general plan and hydraulic plan of the STP is also shown in Figures 3.4.1 and 3.4.2, respectively. Other detailed drawings are contained in Appendix 3.4.1.

Table 3.4.1 Outline of Pagla Sewage Treatment Plant

1. General

Name:	Pagla Sewage Treatment Plant
Location:	Dhaka City, Pagla District
Site Area:	110.5 ha (whole area) 87.7 ha (present site area)
Ground Level:	Present GL = +1.8 to +6.9 Design GL = +6.7 to +6.9
Land Use:	East - farming, West - railroad and industrial area, North - marsh, South - farming
Sewerage System:	Separate system
Treatment Method:	Sewage Treatment = primary sedimentation tank + facultative lagoon Sludge Treatment = sludge lagoon (digestion and drying)
Receiving Water Body:	Buriganga River H.W.L. = +6.7

Design Sewage Flow Rate

Unit: cu.m/day

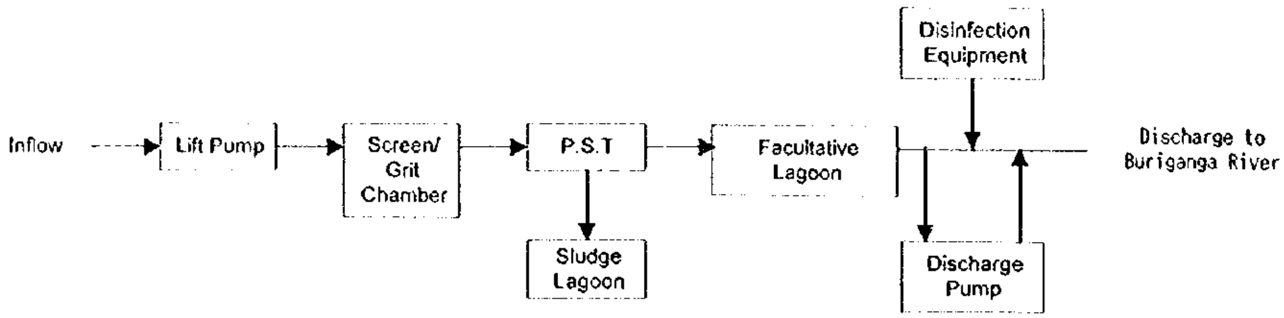
Sewage Flow	Whole Plan	Existing Facility
Daily Average	146,000	96,000
Daily Maximum	183,000	120,000
Hourly Maximum	232,000	120,000

Design Sewage Effluent Quality

Water Quality Index	Influent	Primary Sedimentation Tank		Facultative Lagoon		Total Removal Ratio
		Removal Ratio	Effluent	Removal Ratio	Effluent	
	(mg/l)	(%)	(mg/l)	(%)	(mg/l)	(%)
BOD	200	40	120	59	50	75
SS	200	60	80	25	60	70

Table 3.4.1 Outline of Pagla Sewage Treatment Plant (continued)

2. Treatment Flow



3. Outline of Major Facilities

Facility	Dimension	No. of Facility		Capacity
		Existing	Whole	
Inflow	Brick Arch Sewer Dia. Ø54" (Equ.) Slope 0.45% Sewer Pipe Invert Level +0.762 Sewer Dia. Ø1800 Slope 0.45% Invert Level +0.485	1 -- 	1 1 	
Lift Pump	Screw Pump Ø1,600 x 41 m³/min. x 3.8 m x 45 kW	3 (1)	5 (1)	
Grit Chamber	Horizontal Flow Type W 3.3 m x L 10.2 m x D 1.42 m	2	2	Overflow Load: 3,600 m³/m² x day
Primary Sedimentation Tank	Centrifloc Sludge Scraper Ø33 m x D 3.0 m	4	6	Detention Time: 2.02 hr. Overflow Rate: 35.7 m³/m² x day Weir Loading: 293 m³/m x day
Facultative Lagoon	Embanked Rectangular Pond Effective Depth: 2.0 m	42 ha	64.1 ha	Retention Days: 7 BOD Area Load: 343 kg BOD/ha x day
Discharge Pump	Horizontal Centrifugal Pump Ø250mm x 4.55m³/ min x 10.7 m Ø250mm x 11.36m³/ min x 10.7 m Ø400mm x 31.82m³/ min x 10.7 m	 2 2 3	 2 2 3	
Disinfection Equip.	Liquid Chlorine	1	1	Max. Dosing Rate: 3 mg/l
Sludge Lagoon	Embanked Rectangular Pond	3	3	Solid Loading 75 kg/cu.m x year
Discharge Pipe	Brick Arch Inflow Ø1,350 Inflow Ø1,500 Length 1,240 m	 1 1	 -- 2	Gravity flow only

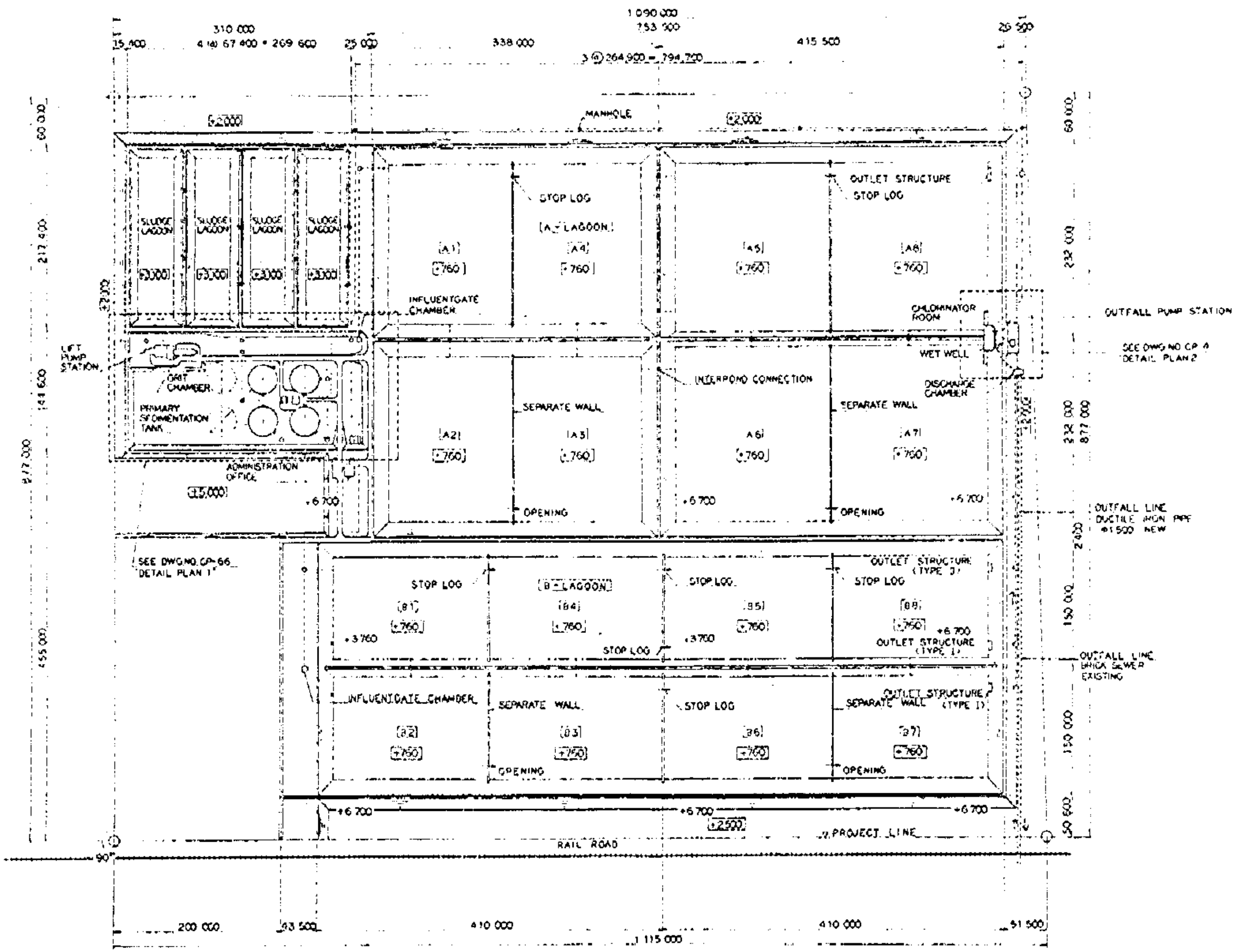


Figure 3.4.1

General Plan of Pagla STP

The Study on North Dhaka Sewerage System in North Dhaka

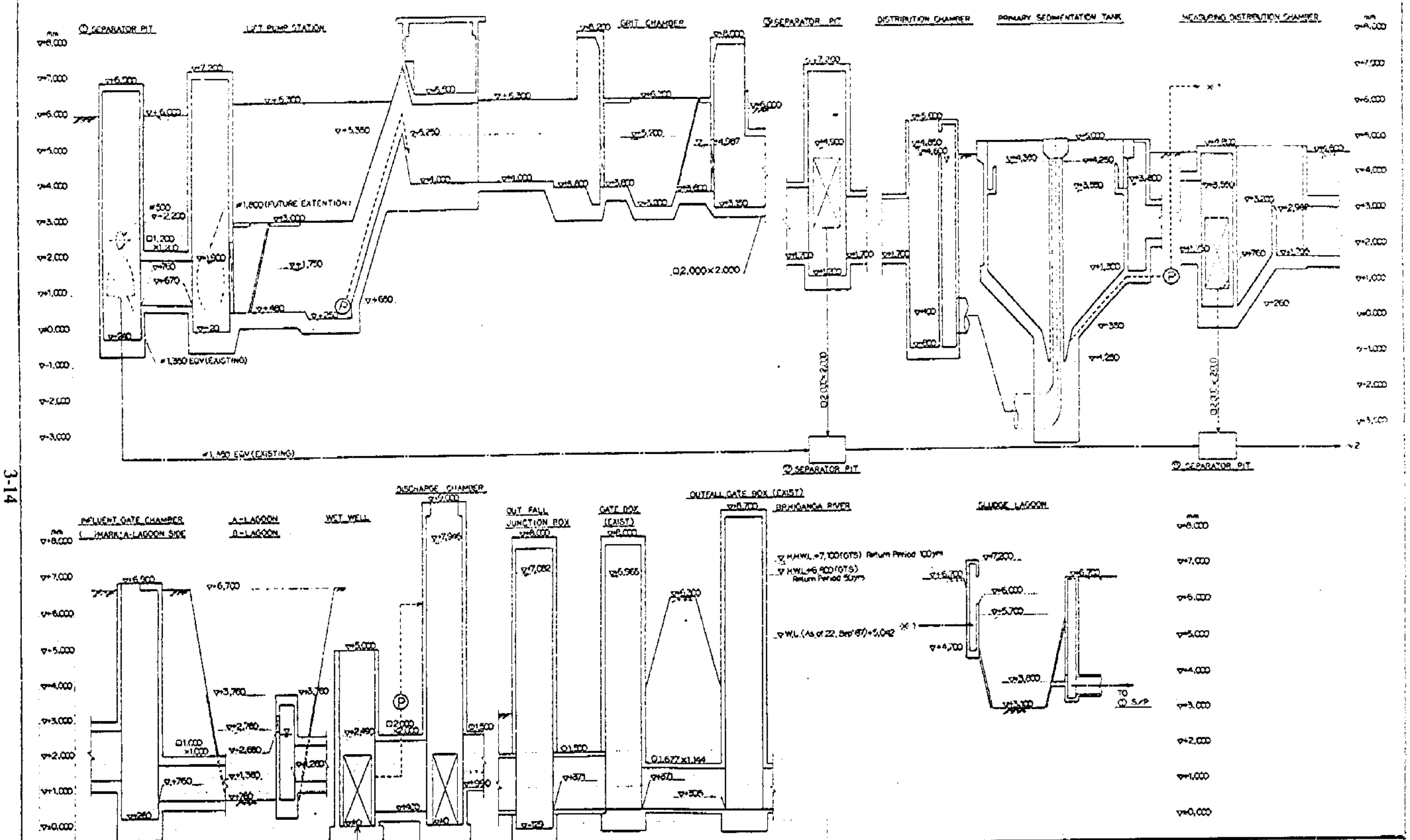


Figure 3.4.2

Hydraulic Profile of Pagla STP

The Study on North Dhaka Sewerage System in North Dhaka

The present status of the facilities are shown below:

Table 3.4.2 Present Status of Pagla STP

Facility	Present Status
Lift Pump	All operational
Grit Chamber	Operational
Primary Sedimentation Tank	All operational
Facultative Lagoon	Operational
Discharge Pump	All operational
Disinfection Equipment	Chlorinator is now under repair Maintenance of chlorinator is under the jurisdiction of the Structure Maintenance Division in DWASA

Minor breakdowns can be repaired by the Pagla maintenance team. In a case of major repair, the Pagla staff will prepare an estimate and call the contractors registered in DWASA for the tender. The successful tenderer will undertake the repair work.

3.4.2 Practice of Operation and Maintenance

The plant is operated by three shifts and the staff composition is as follows:

Table 3.4.3 Staff Composition of Pagla STP

Position	No.	Position	No.
Executive Engineer	1	Driver	2
Subdivision Engineer	1	Utility Man	2
Sub-assistant Engineer	2	Gardener	1
Microbiologist	1	Office Cleaner	1
Sample Collector	1	Wireless Operator	1
Foreman	1	Generator Operator	2
Electrician	1	Treatment Plant Assistant	6
Cashier	1	Pump Operator	8
Typist & Clerk	1	Helper	8
Store Keeper	1	Sewer Cleaner	13
		Total	55

The monthly total expenditure and its breakdown as of the year 1996 is shown below. This includes that of the Narinda P/S and other L/Ss.

Table 3.4.4 **Monthly Expenditure Breakdown for Pagla STP and Narinda P/S and L/S (1996)**

Unit: Tk

Items	Jan.	Feb.	Mar.	Apr.	May	Jun.
Salary	295,938	223,380	212,340	287,512	220,135	207,223
O&M Costs	284,788	270,558	275,435	280,530	285,631	283,780
Spare Parts	5,700	6,000	7,000	3,000	8,000	9,000
Electricity	196,354	195,394	195,394	408,042	408,042	408,042
Others	20,000	20,000	20,000	20,000	20,000	20,000
Total	802,780	715,232	710,169	999,084	941,807	928,028

Items	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Salary	209,180	219,310	217,916	224,309	227,988	217,894	2,763,125
O&M Costs	290,195	278,290	279,355	278,780	286,996	275,855	3,370,193
Spare Parts	9,500	7,000	8,000	7,500	9,000	6,000	85,700
Electricity	496,291	463,947	463,947	242,045	242,045	256,973	3,976,515
Others	20,000	20,000	20,000	20,000	20,000	20,000	240,000
Total	1,025,166	988,547	989,218	772,634	786,029	776,722	10,435,533

3.4.3 Incoming Sewage Flow

Incoming sewage flow is measured at the measuring chamber at the upstream of Lagoon A and B on an everyday basis. Recorders calibrate the overflow depth by the measuring scale attached to the vertical wall beside the weir and calculate the incoming flow to each lagoon by a calculation chart. The monthly average flow for the last one-year (1996) was as follows:

Table 3.4.5 Monthly Average Incoming Sewage Flow at Pagla STP (1996)

Unit: cu.m3/day

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.
Average Flow	40,505	38,359	42,840	42,625	47,657	57,702
Month	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Average Flow	53,245	51,672	46,890	42,904	38,167	34,903
				Annual Average		44,539

Considering the design capacity of the plant, 120,000 cu.m/day, the incoming sewage flow is only equivalent to 32.0% (minimum), 44.4% (maximum) and 37.1% (average). Thus, the existing facilities are in operation partially; they are: 1 No. of inlet screw pump (total 3 Nos.), 2 Nos. of primary sedimentation tank (total 4 Nos.), facultative lagoon (8 Nos.; all), discharge pump (operated depending on the water level of the receiving water body: Buriganga River) and 1 No. of sludge lagoon (total 3 Nos.).

3.4.4 Treatment Performance

A laboratory room is equipped in the administration building. Samples are taken one a week at:

- Distribution Chamber
- Outlet Primary Sedimentation Tank
- Outlet of A and B Lagoon

A microbiologist analyses the SS and BOD_5 for each sample. However the BOD_5 meter was disabled last 20 October, 1995 and thus only SS is measured and recorded at present. Table 3.4.6 shows the existing water analysis equipment in the laboratory room in the Pagla STP.

Table 3.4.6 Existing Water Analysis Equipment in the Pagla Laboratory

Item	Type and Manufacturer	No.	Present Status
Digital DO/O Meter	Bionic Industry Co., Ltd. DO-715k	1 unit	Non-functional
pH Meter	Horiba	1 unit	Functional
Drying Oven	Yamato	1 unit	ditto
Incubator	Sanyo	1 unit	ditto
Vacuum Pump	Yamato	1 unit	ditto
Glassware	Yamato	1 set	

The monthly average BOD_5, SS and their removal rate in a one-year period, from November 1994 to October 1995, is shown below.

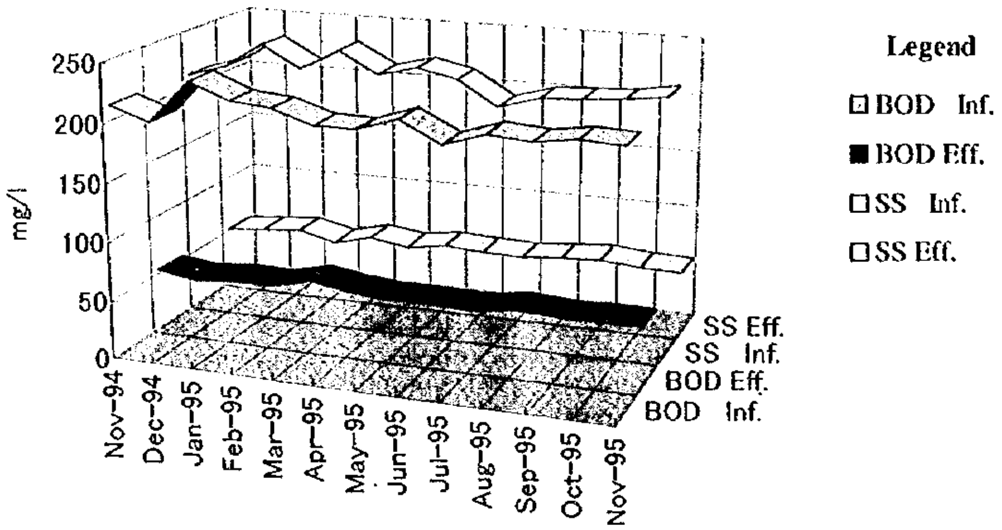
Table 3.4.7 Water Quality and Removal Rate of BOD_5 and SS

Item	BOD_5					SS				
Month/ Year	Inf. (mg/l)	P.S.T. Eff (mg/l)	P.S.T. Eff R.R. (%)	F.L. (mg/l)	Overall R.R. (%)	Inf. (mg/l)	P.S.T. Eff. (mg/l)	P.S.T. Eff. R.R. (%)	F.L. (mg/l)	Overall R.R. (%)
Nov. 96	213	116	45.5	53	75.1	211	106	49.8	51	75.8
Dec.	202	111	45.0	48	76.2	221	105	52.5	55	75.1
Jan. 97	238	128	46.2	51	78.5	243	111	54.3	58	76.1
Feb.	225	121	46.2	52	76.9	225	122	45.8	50	77.8
Mar.	222	122	45.0	60	73.0	243	126	48.1	58	76.1
Apr.	211	114	46.0	54	74.4	225	90	60.0	53	76.4
May	211	116	45.0	51	75.8	233	89	61.8	58	75.1
Jun.	222	121	45.5	52	76.6	226	92	59.3	56	75.2
Jul.	205	120	41.5	50	75.6	205	80	61.0	55	73.2
Aug.	216	124	42.6	55	74.5	215	84	60.9	58	73.0
Sep.	213	122	42.7	53	75.1	217	88	59.4	60	72.4
Oct.	218	120	45.0	53	75.7	219	85	61.2	57	74.0
Avg.	216	120	44.7	53	75.6	224	98	56.2	56	75.0

Note: Inf. = Influent, P.S.T. = Primary Sedimentation Tank, Eff. = Effluent, R.R. = Removal Rate, F.L. = Facultative Lagoon.
During the field survey of L/Ss in industrial area, some industrial sewage was connected to the

public sewerage system and other was discharged to the pond or channel nearby just as the case of Hazaribag L/S in MODS Zone II (please refer Appendix 3.3.1). Thus, incoming sewage to Pagla STP was comprised of domestic/industrial sewage. Figure 3.4.3 shows the influent and effluent quality fluctuation through the year.

Figure 3.4.3 Influent & Effluent Water Quality Fluctuation



The treated sewage is discharged to the Buriganga River through discharge trunk by gravity or by discharge pump, depending on the level of the river.

As shown in Table 3.4.7, the average overall removal rate is 75.6% for BOD_5 and 75.0% for SS. Although the present treatment performance complies with the design removal rate, which is 75.0% for BOD_5 and 70.0% for SS, the effluent quality (BOD_5) exceeds the existing DOE effluent standards shown below.

Table 3.4.8 DOE Effluent Standards

Water Quality Index	Unit	Standard Value
BOD_5	mg/l	40
Nitrate	mg/l	250
Phosphate	mg/l	35
SS	mg/l	100
Temperature	°C	30
Coliform	number/100 ml	1,000

The equipment of the laboratory should be improved immediately. Given the location of the plant and the budget restrictions, the water quality analysis cannot be covered by a private or governmental laboratory. Thus, the laboratory should be properly equipped at least for stable

SS and BOD_5 measurement.

3.5 Central Store

The Central Store, belonging to the Store Division, is located just beside the Pagla STP. All purchased equipment or materials are transported here, checked, registered and then distributed to Zone Offices. In an area of 16.0 ha, there are three warehouses and one office building. Electrical and mechanical equipment is stored in warehouses and pipes, bends and valves are kept in open spaces without roofing. The staff composition is as follows:

Table 3.5.1 Staff Composition of Central Store

Position	No.	Position	No.
Executive Engineer	1	Generator Operator	1
Subdivision Engineer	1	Mechanic	1
Assistant Engineer	1	Gardener	5
Sub-assistant Engineer	4	Additional Pump Operator	5
Upper Divisional Assistant	2	Warehouse Man	3
Typist	6	Helper	6
Revenue Inspector	1	Utility Man	2
Driver	1	Office Cleaner	4
		Total	44

The monthly expenditure and its breakdown for the last year (1996) are shown below.

Table 3.5.2 Monthly Expenditure and Breakdown for Central Store

Unit: Tk

Items	Jan.	Feb.	Mar.	Apr.	May	Jun.
Salary	107,466	79,789	106,182	194,473	105,943	113,414
O&M Costs	15,207	64,514	10,496	63,935	15,138	171,298
Spare Parts	-	-	-	-	-	-
Electricity	34,518	28,069	28,069	28,069	28,069	28,069
Others	305	415	313	311	311	438
Total	157,476	172,787	145,060	286,788	149,506	313,219

Items	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Salary	111,440	115,124	115,807	117,318	114,885	117,186	1,399,007
O&M Costs	16,533	15,510	15,470	84,647	11,446	16,357	500,616
Spare Parts	-	-	-	-	-	-	-
Electricity	31,683	31,683	31,683	35,021	35,021	37,246	377,200
Others	321	238	174	468	630	694	4,618
Total	159,997	162,555	163,134	237,454	161,982	171,483	2,281,441

O&M cost includes the cost for fuel and building expansion and repair.

The stores warehouse over 400 categories of goods. At present, they are recorded manually and there might be serious trouble related to miswriting or miscalculation. For efficient store management, DWASA is planning to introduce a computer system. The Physical Inventory Report was completed on 30 June, 1996 and it contains the following information:

10 digit Code No. (for instance 1120602121)

- Name of material/equipment (for instance, material corresponding to the above Code No. is: 4 inch x 11.25 inch PVC Bend, B-Class)
- Date of Inventory
- Quantity as per book balance as of the end of the fiscal year S/A: Serviceable, U/S: Un-serviceable, Total)
- Quantity received thereafter up to the date of the inventory (S/A, U/S)
- Total quantity on the inventory date (S/A, U/S, Total)
- Quantity issued upon the date of the end of the financial year (S/A, U/S)
- Balance quantity after the issue as on the inventory date (S/A, U/S)
- Actual found on the inventory date (S/A, U/S, Total)
- Shortage/exceeded for the last year (S/A, U/S, Total)
- Shortage/exceeded for the previous year (S/A, U/S, Total)

3.6 Workshop

The workshop, belonging to the Workshop Division of DWASA, is located besides the MODS Zone IV Office in Mirpur. Within an area of 5,000 sq.m, there is one garage, two office buildings, one roofed working space and one repair shop. Staff composition, a list of existing equipment and the repair record are shown below.

Table 3.6.1 Staff Composition of Workshop

Position	No.	Position	No.
Subdivision Engineer	2	Assistant Mechanic	2
Sub-assistant Engineer	6	Electrical Worker	2
Cashier	2	Assistant Electrical Worker	2
Typist	3	Machinist	2
Electrician	1	Assistant Machinist	2
Foreman	2	Welder	1
Store Keeper	1	Winder	1
Store Assistant	1	Assistant Winder	1
Mechanic	2	Helper	9
		Utility Man	1
		Total	43

Table 3.6.2 List of Existing Equipment

Items	No.	Items	No.
16 ft. - 0 in. Lathe	1	Grinder	2
6 ft. - 0 in. Lathe	1	Radial Drill	1
4 ft. - 0 in. Lathe	1	Hand Grinder	1
Power Hacksaw	1	Hand Drill	1
Metal Cutter	3	Welding Machine	3
Twist Drill	2	Air Compressor	1
Shaper	1	Hand Tool (set)	1

Table 3.6.3 Record of Repair Works (as of September, 1996)

Items	No.
Water Carrier	14
Generator	4
Machine Shop	25
Microbus	2
Pick-up	3
Car	17
Tempo	0

The workshop repairs vehicles, pumps, generators, etc. from the Zone Offices. The existing system is as follows: first, they check the condition of the machine and find out which part should be replaced; second, purchase the required spare parts in the parts shop in the city; third, repair the machine. However, this procedure takes a great deal of time and for more efficient repair work, they are requesting that DWASA construct a spare parts store. If the required part is available in that store, repair work can be finished in half the time as that required by the present system. The O&M budget for the last is shown below.

Table 3.6.4 O&M Budget for the Workshop (1996-1997)

Item	Cost (Tk)	Item	Cost (Tk)
Overtime	438,900	Office Maintenance	71,668
Transportation	11,400	Vehicle Maintenance	2,850,000
Labour	84,098	Fuel	617,000
Telephone	120,745	Other Expenses	900
Advertisement	-	Furniture	4,465
Printing and Stationary	219,451	Motor and Generator	4,090,000
		Total	8,509,127

CHAPTER 4

PAST AND ON-GOING PROJECTS RELATED TO SANITATION/SEWERAGE FACILITIES

CHAPTER 4 PAST AND ONGOING PROJECTS RELATED TO SANITATION/SEWERAGE FACILITIES

The past and ongoing projects which might be related in formulating the master plan for the North Dhaka Sewerage Development are outlined below.

4.1 "Basic Design Study Report on the Sewerage Construction and Rehabilitation Project for Dhaka City", Japan International Cooperation Agency, February 1988

The study was conducted from September 1987 to February 1988. Consequently, the following lines were established to construct/rehabilitate/provide facilities/equipment (see Table 4.1.1) under the Japanese Grant-Aid Program which was commissioned to the Dhaka Water Supply and Sewerage Authority in March 1992.

(1) Sewage Treatment Plant

- rehabilitation of the Pagla Sewage Treatment Plant with a daily maximum treatment capacity of 120,000 cu.m/day.

(2) Lift Station

- replacement of pumps out of order,
- construction of a screen chamber at each lift station,
- construction of a grit chamber at the Narinda Pump Station,
- equipment of starters with static condensers and time recorders, etc.

(3) Sewer System

- rehabilitation of defective sections between lift stations,
- rehabilitation of some pipes on the delivery of lift stations.

Table 4.1.1 Facilities/Equipment Constructed/Rehabilitated/Provided

Item	Configurations/Specifications	Qty	Remarks
Pagla Sewage Treatment Plant			
Lift Pump	Screw Pump ϕ 1,600mm x 41m^3/d x 3.8mH x 45kw	3	One for standby
Grit Chamber	Parallel Flow 3.3mW x 10.2mL x 1.42mD	2	
Primary Sedimentation Tank	Center-Feed Circular w/ Sludge Scraper ϕ 33m x 3.0mD	4	
Facultative Lagoon	Rectangular Embankment Effective Water Depth : approx. 2.0m	14.8ha	
Disinfection Equipment	Chlorinator	1	
Sludge Lagoon	Rectangular Embankment 59.1mW x 169.1mL x 3.6mD	3	
Outfall Pipe	ϕ 1,500mm x approx. 1,240m	1	Existing one (54") is used, if the gravity drainage is possible
Administration Bldg.	Office, Electrical Room	1	Two-stories
Diesel Engine Generator	375KVA	2	Near admin. office and outfall pumping station, respectively
Lift and Pumping Station			
Hazaribag LS	Submergible Pump ϕ 200mm x 2.3m^3/d x 17mH x 22kw ϕ 200mm x 4.6m^3/d x 17mH x 30kw	2 2(1)	Replacement of pumps
Nawabganj LS	Submergible Pump ϕ 150mm x 2.3m^3/d x 9.2mH x 11kw	2(1)	ditto
Faridabad LS	Submergible Pump ϕ 150mm x 2.3m^3/d x 7mH x 7.5kw	2(1)	ditto
Old Narinda PS	Submergible Pump ϕ 300mm x 11.4m^3/d x 12.2mH x 37kw ϕ 400mm x 31.9m^3/d x 12.2mH x 85kw	2(1) 2(1)	ditto
Screen Chamber			All stations
Grit Chamber			New Narinda PS
Overhead Traveling Crane	10 metric tons	1	Old Narinda PS
Diesel Engine Generator		10	8 units : fixed type 2 units : non-fixed type
Submerged Motor Pump	2.3 - 4.6 m3/min	6	
Others			Vacuum pump, sump pump, control panel, level gauge, etc.
Replacement of Sewers			
Faridabad LS	ϕ 500mm x 1,500m		Discharge pipe
Faridabad LS	ϕ 16" x 400m		Discharge pipe
Asad Gate To Tejgaon LS	ϕ 24" x 150m		
Gulshan to Tejgaon LS	ϕ 24" x 100m		
Tejgaon to Swaminbag LS	ϕ 36" - 48" eqv. x 200m		
Old Narinda PS	ϕ 42" x 85m		Discharge side header pipe
New Narinda PS	Inlet Pipe, Sump Pit		

4.2 **"Water Treatment Plant at Demra and Other Works - Interim Report (Water Supply)", Camp Dresser & Mckee International Inc. USA, et al., November 1989**

Included as part of the DWASA IV Project was the design of a 450,000 cu.m/day Demra Water Treatment Plant. In addition to the initial works, the plant was to be arranged in a manner that would allow easy expansion to 910,000 cu.m/day at some future date. The plant, which would withdraw water from the Lakhya River, was comprised of the following works:

- river intake on the Lakhya River with provisions for coarse screening,
- raw water pumping station with fine screening located at the river edge with pipeline to convey water to the treatment plant,
- water treatment plant,
- treated water clearwell and finished water pump station and pipeline to transmission system.

These works were all to be constructed on the Demra site located about 8 km east of central Dhaka. This site was identified in a 1959 master plan for water supply system for Dhaka and is currently owned by Dhaka WASA. The site is situated on the west bank of the Lakhya River just upstream from its confluence with the Balu River.

4.3 **"Water Treatment Plant at Demra and Other Works - Interim Report (Sewerage)", Camp Dresser & Mckee International Inc. USA, et al., February 1990**

A feasibility study was undertaken by RMP/Montgomery on behalf of the DWASA for a long term plan through the year 2010 on water supply and sewerage system within the Dhaka metropolitan area. The final report of the study produced in 1981, recommended that in order to ease the crisis of safe water supply and sanitation problem in Dhaka City and adjoining areas, a priority programme consisting of critical water and sewerage elements below from Phase 1 of their Long Term Plan Development (LTP) be started immediately.

- upgrading of the Pagla Sewage Treatment Plant from 180,000 cu.m/day to 270,000 cu.m/day,
- construction of major sewage pumping station 5 nos.

- construction of major sewer force main with diameters varying from 100 cm to 244 cm 34 km
- construction of local sewage pumping station 10 nos.
- construction of secondary sewer force mains and laterals 23 km
- construction of community sanitation blocks 700 nos.
- installation of sewer service connections 46,000 nos.

In compliance with this recommendation, the DWASA investigated the "Water Treatment at Demra and Other Works" project to meet the main objectives of the priority programme for sewerage, or to develop the sewage disposal system to meet the immediate need and to lay a firm foundation for future development.

The scope of works defined the sewerage elements of the priority programme as:

- upgrading of the Pagla Sewage Treatment Plant from 180,000 cu.m/day to 270,000 cu.m/day
- construction of major sewage pumping station 5 nos.
- construction of major sewer force main of diameter varying from 100 cm to 244 cm 34 km
- construction of local sewage pumping station 10 nos.
- construction of secondary sewer force mains and laterals 23 km

In the study, some original sites and routes for regional pumping stations and trunk mains were modified from those in the LTP as shown in Figure 4.3.1. As the results of the study, many of the existing pumping stations and sewers are presently running at close to their design capacity with several instances where they have already been well exceeded, especially in the Gulshan/Banani area. In the next few years, all the stations and sewers will become overloaded and major sewage flooding can be expected unless upgrading works are undertaken and flows diverted to the proposed regional main as necessary. It was therefore proposed that flows should be diverted from the system according to the schematic diagram as given in Figure 4.3.2 involving the construction of diversion sewers, pumping stations and mains to discharge the flows to the Baridhara trunk sewer.

The design criteria adopted in the study are as follows:

Figure 4.3.1

Proposed Dhaka Sewerage System by CDM

The Study on the Sewerage System in North Dhaka

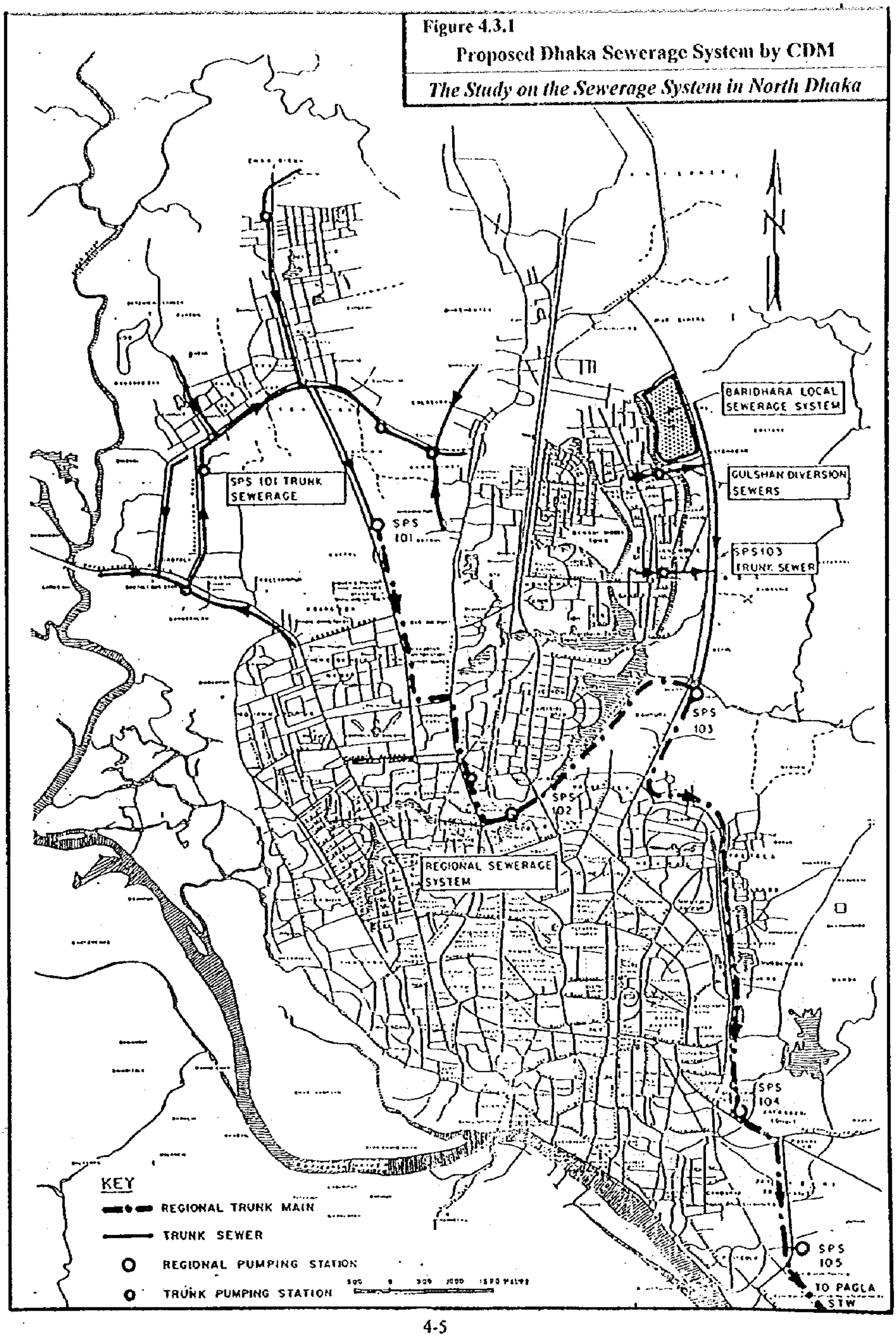
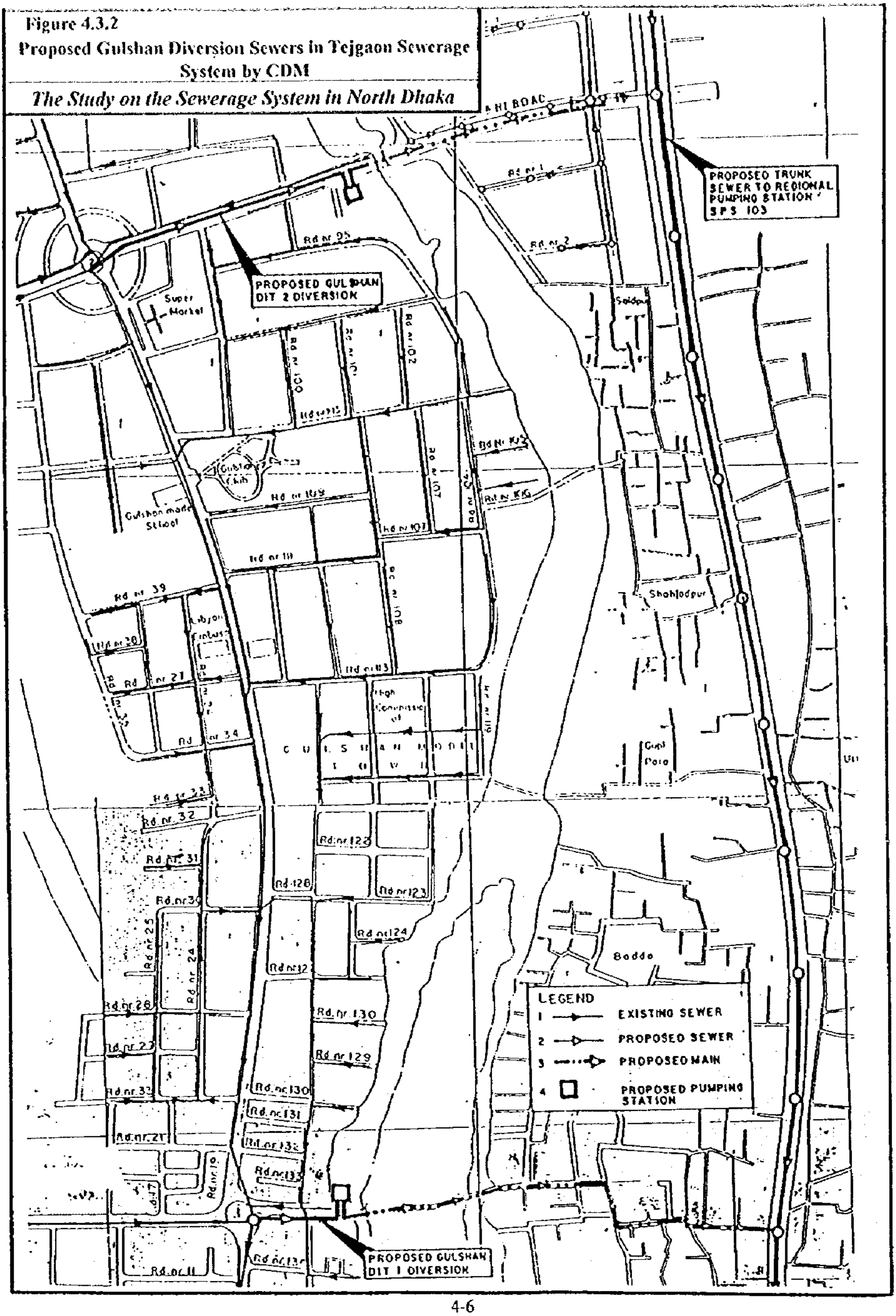


Figure 4.3.2
Proposed Gulshan Diversion Sewers in Tejgaon Sewerage System by CDM

The Study on the Sewerage System in North Dhaka



(1) Population

Table 4.3.1 Population Projection and Distribution

Location	Area (ha)	Population Density (pop/ha) 1990	2000	2010	Estimated Population 1990	2000	2010	Per Capita Consump. (lpcd)
1 Pallabi-Mirpur	1,311	340	415	490	445,740	544,065	642,390	154
2 Dar-as Salam	1,198	340	435	530	407,320	521,130	634,940	155
3 Dhanmondi	688	400	570	740	275,200	392,160	509,120	179
4 Tejgaon	517	670	705	740	346,390	364,485	382,580	104
5 Baridhara-Badda	646	110	235	360	71,060	141,810	222,560	212
6 Rampura	323	520	605	690	167,960	195,415	222,870	166
7 Maghbazar	381	720	745	770	274,320	283,845	292,370	125
8 Madertek	1,037	320	375	430	331,840	388,875	445,910	93
9 Jatrabari	598	540	680	820	322,920	406,640	490,360	128
10 Islambagh	149	1,060	1,150	1,240	157,940	171,350	184,760	150
11 Hazaribagh	366	840	900	960	307,440	329,400	351,360	237
12 Armanitola	316	1,060	1,150	1,240	334,960	363,400	391,840	111
13 Wari-Gandaria	642	910	1,010	1,110	584,220	646,420	712,620	124
14 City Centre	683	990	1,050	1,110	676,170	717,150	758,130	85
15 Mohammadpur	605	400	515	630	242,000	311,575	361,150	168
16 Banani-Gulshan	850	230	435	640	195,500	369,750	544,000	232
Total	10,310				5,140,980	6,159,470	7,177,960	

(2) Per Capita Sewage Flow

Table 4.3.2 Assumption for Per Capita Sewage Flow

Description		1990	2010		Ultimate	
Type of Facility			Sewerage	Community Sanitation	Sewerage	Community Sanitation
Population Density (pop/ha)	>500		50%	50%	95%	5%
	<500		-	100%	50%	50%
Sewage / Water	Domestic	(see Table 4.3.4)	70% (see Table 4.3.2)	30 lpcd	70%	30 lpcd
	Urban Service		70% (eqv. 10 lpcd)		70% (eqv. 10 lpcd)	
	Industrial		75%		75%	
	Waste		100% (eqv. 10% of domestic)		100% (eqv. 10% of domestic)	

Table 4.3.3 Per Capita Sewage Flow by Dhaka WASA Service Zone

Dhaka WASA Service Zone	1	2	3	4	5	6
Per Capita Sewage Flow (lpcd)	56	77	64	-	102	54

Source : "Basic Design Study Report on the Sewerage Construction and Rehabilitation Project for Dhaka City", Japan International Cooperation Agency, February 1988

(3) Average Daily Flows

average daily flows = (population by drainage district) x
(average per capita sewage flow including allowance)

Allowances included for additional flows derived from industrial connections, community services, infiltration, storm water inflow and waste as given as "waste" in Table 4.3.3.

(4) Peak Daily Flows

Peak daily flows were calculated by the application of a peaking factor based on the Hubbit equation.

$$\text{peaking factor (PF)} = 5 / (\text{population} / 1{,}000)^{1/6}$$

4.4 "Updating Study on Storm Water Drainage System Improvement in Dhaka City", Japan International Cooperation Agency, February 1990

The Study on Storm Water Drainage System Improvement Project in Dhaka City was conducted in 1987 and consequently proposed three phased programme for drainage improvement for the City of Dhaka with a total area of 137.5 sq.km. The study urged the immediate implementation of the highest priority programme or Phase-1 which cost Tk 2.61 billion and covered an area of 31.30 sq.km.

In 1988, after Dhaka suffered the worst flood in his history, the Government of Bangladesh approved "the Greater Dhaka Flood Control and Drainage Scheme (GDFCD)" for implementation and also requested the Government of Japan to re-evaluate and update its previous JICA study taking into account the results of related projects which began after the 1988 flood as well as the information gained from the flood itself.

The objectives of the 1989 study were:

- To review and re-assess the area under the Phase-1 Programme to be included in the first priority zone, taking into consideration of the 1988 flood and the ongoing projects.
- To identify the urgent project to be included in the related Phase-1 Programme.
- To prepare the preliminary design for the urgent project mentioned above.

The ten drainage zones in the Phase-1 Programme as shown in Figure 4.4.1 were divided into categories with two different levels of priority. The zones with the highest priority were zones B, C, F and H which had a total area of 49.46 sq.km. Second priority zones are zones A, D, E, G, I and J with an area of 85.39 sq.km. In this new organization , Zone H was shifted to the highest priority from the second priority in the 1987 JICA study due to its rapid urbanization and the serious damage by the 1987 flood.

4.5 "Dhaka WASA IV Project - Saidabad Site Feasibility Study (Final Report)", Camp Dresser & Mckee International Inc. USA, et al., February 1992

Preparation of detailed design of "the Water Treatment Plant at Demra and Other Works" for the DWASA IV Project commenced in April 1989. The work included 454,000 cu.m/day (100 IMGD) water treatment plant at Demra, increasing the capacity of the Pagla Sewage Treatment Plant by 90,000 cu.m/day (20 IMGD) and related pumping stations and pipelines. The project reached the Interim Report stage, including preliminary construction cost estimates.

The DWASA IV Project as formulated was considered unfeasible on financial grounds. The water supply and transmission (based on a 454,000 cu.m/day facility) were estimated to cost about US$ 270 million, and the sewerage component US$ 240 million, resulting in a total cost of about US$ 510 million. Accordingly, the physical dimensions of the project needed to be re-identified within an envelop of affordable costs. The Ministry of Local Government and other Government of Bangladesh officials decided to review whether the Saidabad site might be appropriate for a surface water treatment plant of a smaller size than the one planned at Derma.

The final engineering designs of the water supply and sewerage components were therefore suspended and an Addendum prepared to carry out a feasibility assessment of constructing a surface water treatment plant at Saidabad. If construction of a water treatment plant at Saidabad is found feasible then it would be assessed together with all other options.

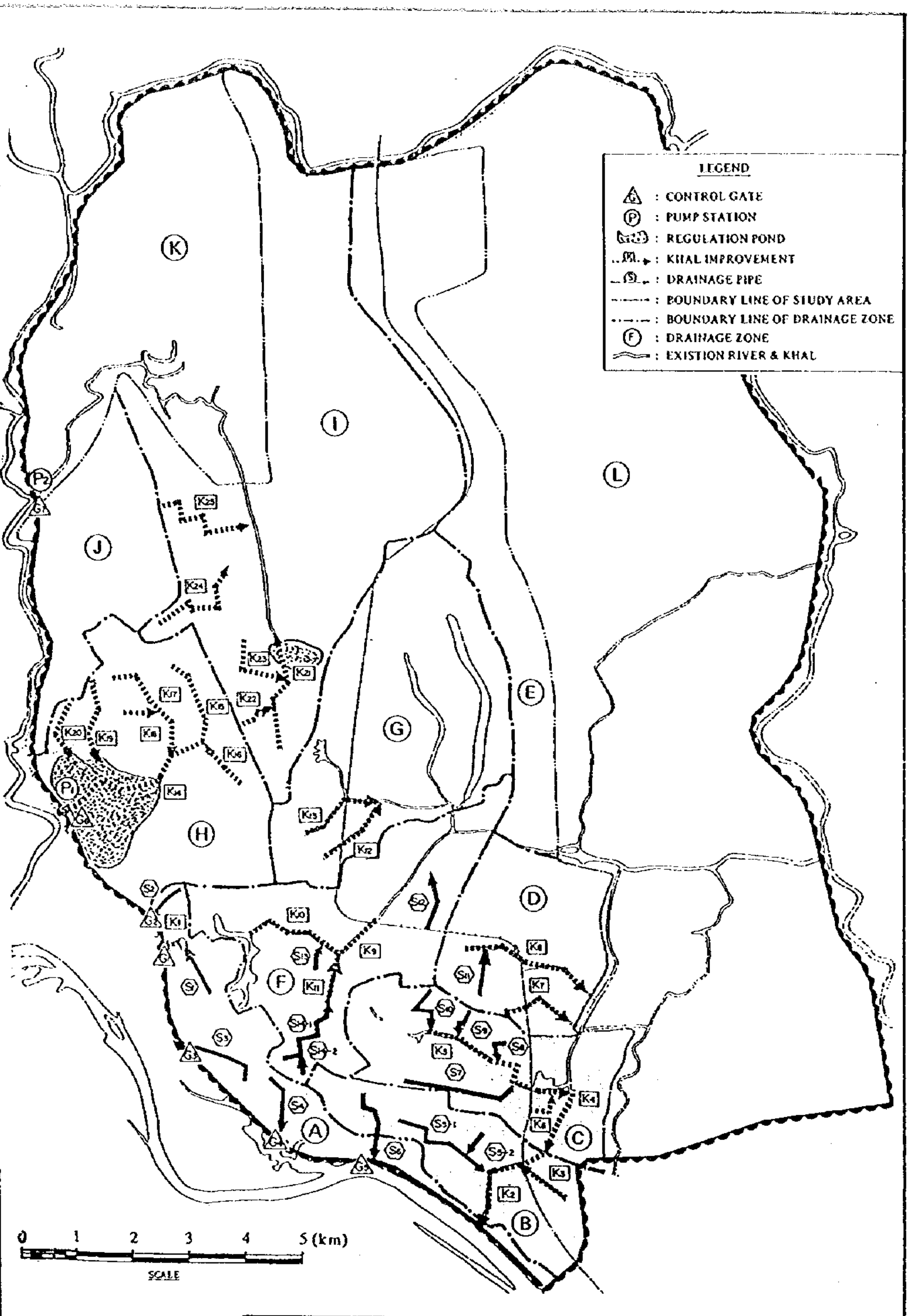


Figure 4.4.1

Proposed Facilities for Storm Water Drainage System Improvement

The Study on the Sewerage System in North Dhaka

As shown in Figure 4.5.1, the Saidabad site is located immediately adjacent to the eastern boundary of Dhaka City on a 55 acre parcel of land owned by DWASA. The site is very near to the transmission corridor from Demra to Jatrabari and also near to a canal (DND Canal) developed earlier by Bangladesh Water Development Board for an irrigation project which is not being used now since the poldered area is transforming into a city suburb. This canal could carry the raw water from Demra.

In the study, five intake options were considered at four different locations as shown in Figure 4.5.2 and described below.

Option A	at Demra proposed for the Demra Water Treatment Plant
Option B	about 400 m downstream of the confluence of the Balu River
Option C	about 700 m downstream of the confluence of the Balu River
Option D	at the existing DND Pumping Station to pump water from the river to the DND Canal
Option E	same as Option B (the intake would feed the DND canal by gravity and the canal would be deepened correspondingly)

Through various evaluations, cost estimates were finally made for eight options in the combination of the intake and transmission systems.

Option A1	Intake & PS →→→ force main →→→→→→→→→ WTP w/ DB
Option A2	Intake & PS →→→ DND Canal → culvert →→→→→ WTP w/ PS
Option B1	Intake & PS →→→ force main →→→→→→→→→ WTP
Option B2.1	Intake & PS →→→ DND Canal → PS → force main → WTP
Option B2.21	Intake & PS →→→ DND Canal → culvert →→→→→ WTP w/ PS
Option C2.21	Intake & PS →→→ DND Canal → culvert →→→→→ WTP w/ PS
Option E2.1	Intake → Culvert → DND Canal → PS → force main → WTP
Option E2.22	Intake → Culvert → DND Canal → culvert →→→→→ WTP w/ PS

(where, DB: Desilting Basin, PS: Pumping Station)

The cost comparison showed that the least cost option was Option E2.1 with a cost of Tk 3,198.1 million for raw water intake and transmission facilities as follows:

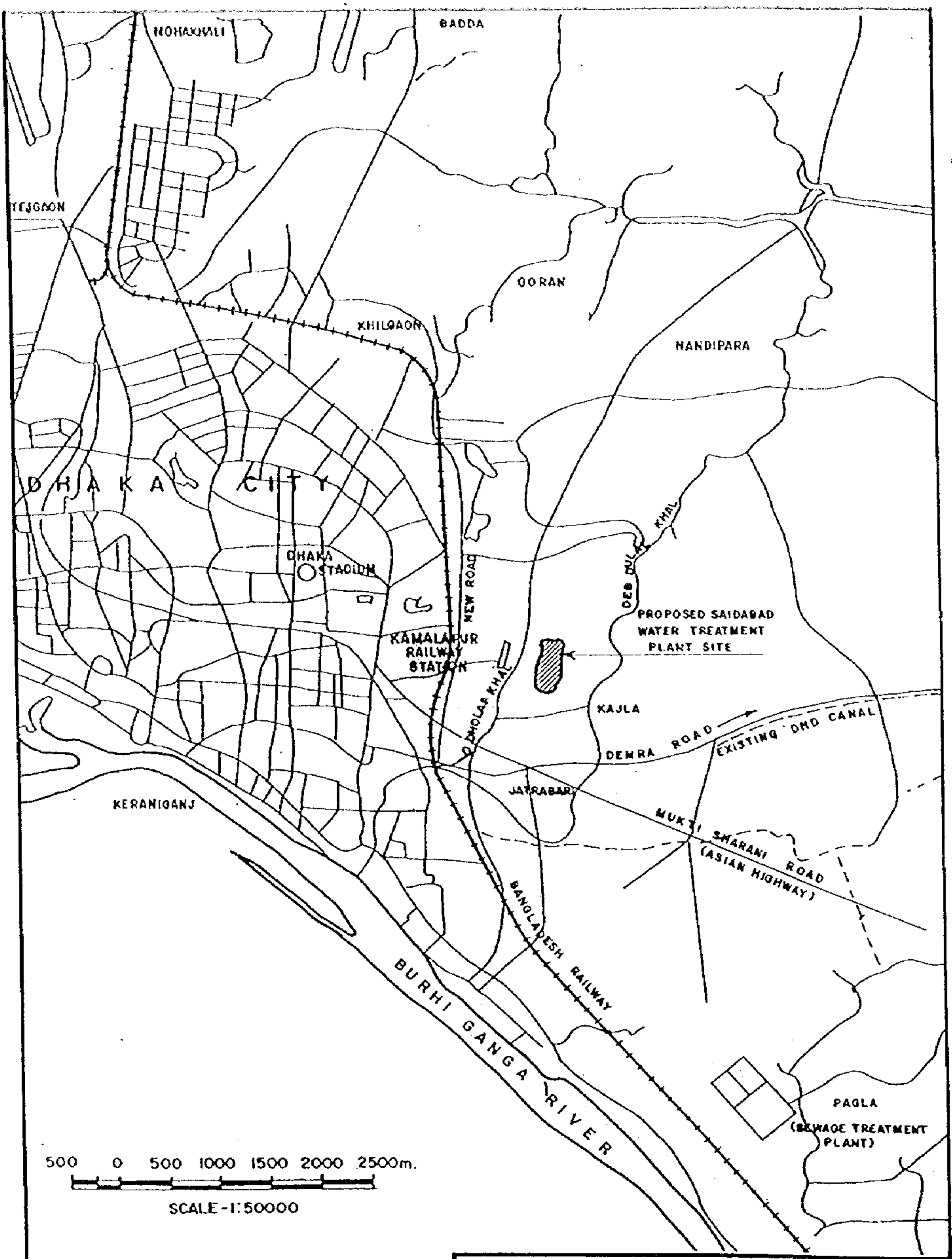


Figure 4.5.1

Location Plan of Saidabad Water Treatment Plant

The Study on the Sewerage System in North Dhaka

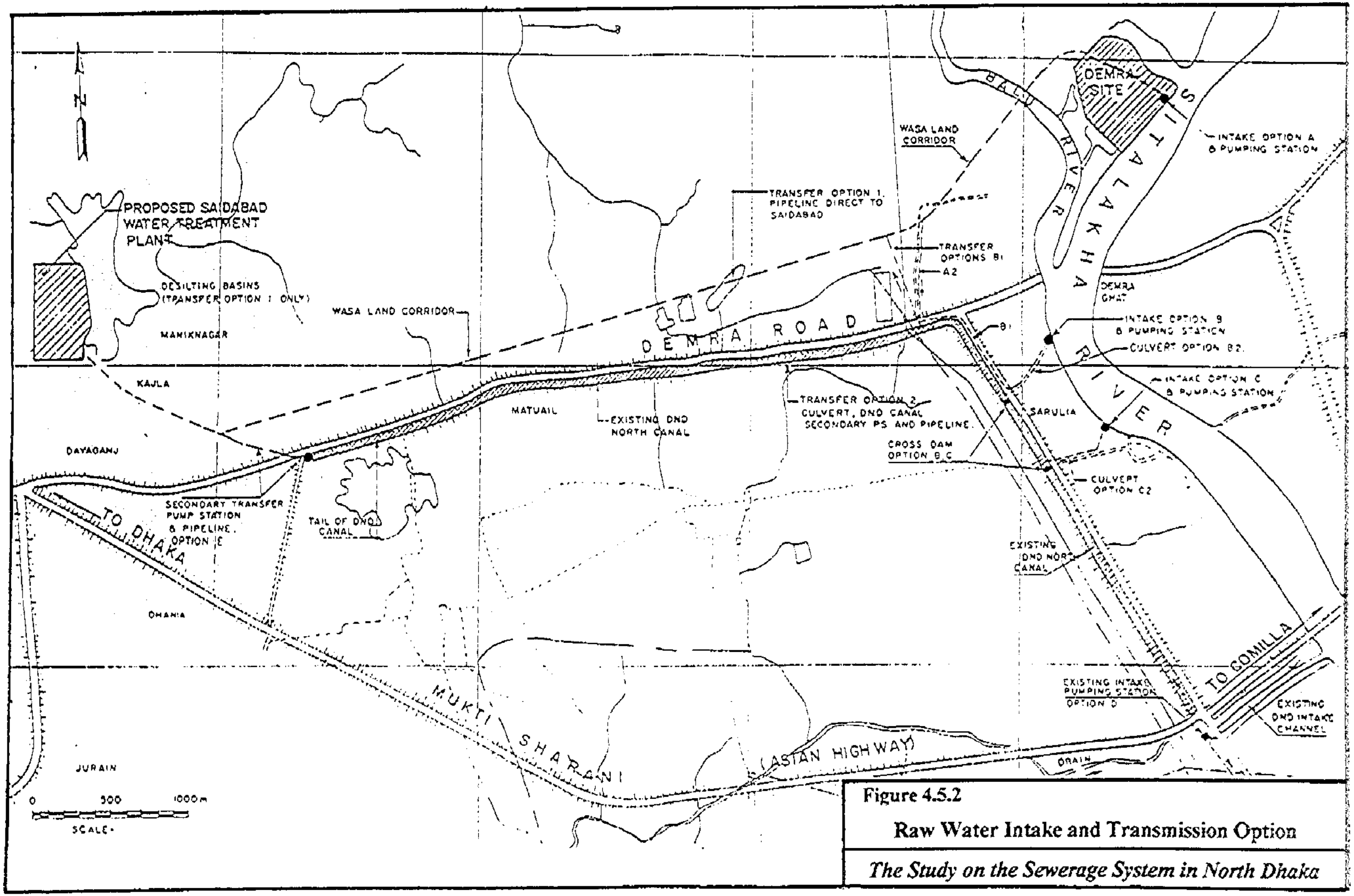


Figure 4.5.2

Raw Water Intake and Transmission Option

The Study on the Sewerage System in North Dhaka

- gravity intake, control structure and intake culvert at Saluria (north)
- deepening and remodelling the DND Canal (to allow gravity inflow)
- intake and pumping station at the tail end of the DND Canal
- pipeline (force main) from the DND Canal to Saidabad

As of July 31, 1997, the detailed design is ongoing in accordance with Option E2.1.

4.6 "Dhaka City Emergency Water Supply Project - Feasibility Study (Final Report) Main Report", BCEOM & Engineering and Planning Consultants Ltd. Bangladesh, May 1992

The objectives of work to be performed under this study were as follows:

- to identify an affordable integrated long term investment programme for DWASA that meets its water needs up to year 2020
- to identify water deficit areas within the city
- to identify present sources of water supply and their possible evolution
- to identify suitable sites for construction of surface water treatments plants
- to design water treatment plant(s) of appropriate size to meet immediate requirements
- to design transmission mains from the treatment plant(s) to serve the deficits area identified above,

leading to identification of an emergency project which can be best incorporated into DWASA's long term development plan.

In the project, the water demand was projected with the per capita consumption and methodology as well as the population as described below.

(1) Population

The methodology for population projection was as follows:

1) The study area was divided into 36 elementary urban zones according to land use. The borders of these zones, which were chosen to coincide as far as possible with the limits of the administrative divisions of the census of 1981, are shown in Figure 4.6.1.

2) The population of each of the 36 elementary urban zones was projected from the results of the 1981 census.

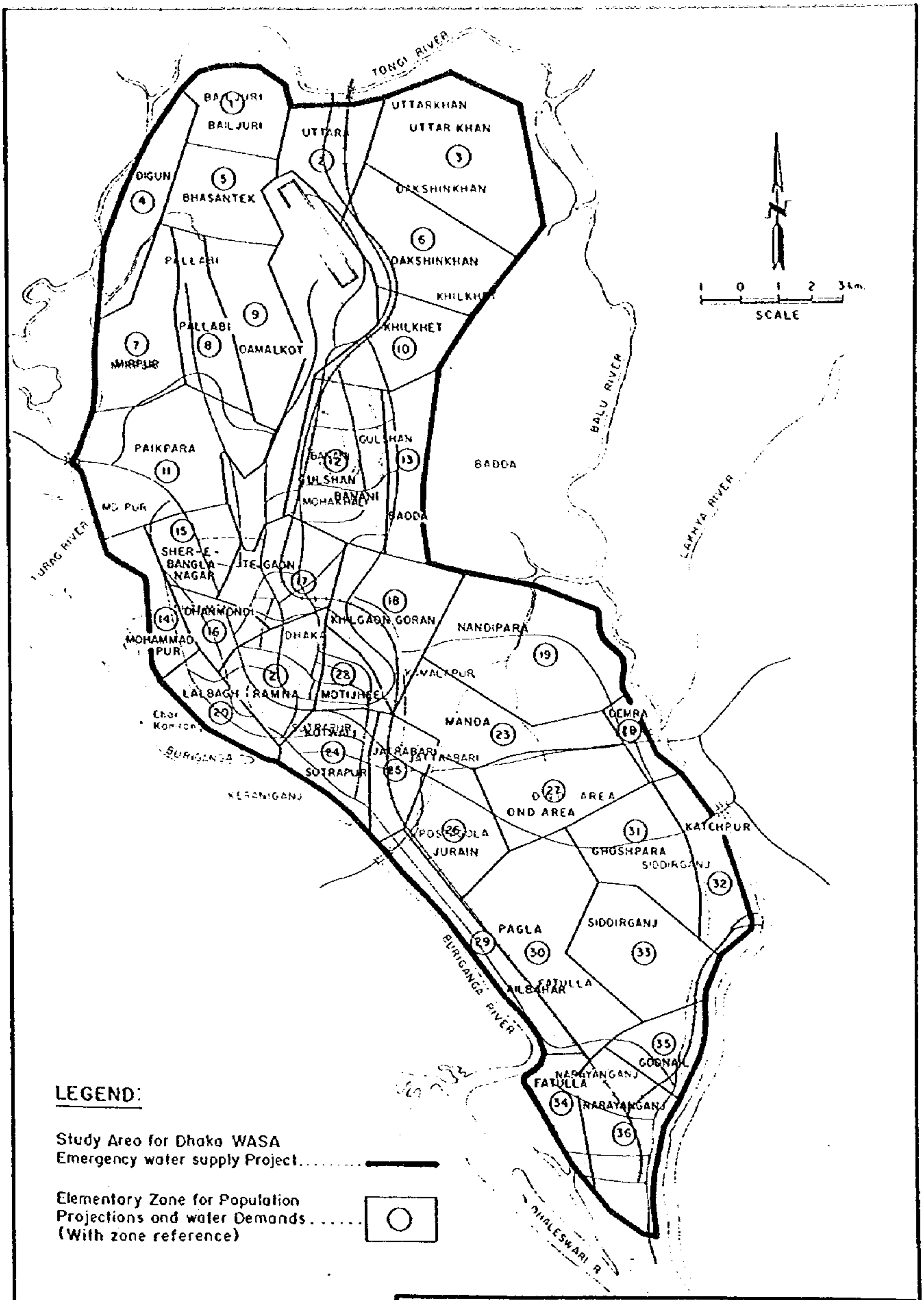


Figure 4.6.1

Study Area and Elementary Urban Zones

The Study on the Sewerage System in North Dhaka

3) For Dhaka City Urban Areas consists of the elementary urban zones no. 7, 8, 9 (40%), 10 (60%), 11, 12, 14-18, 20-22, 24, 25. For each zone, these average growth rates was adjusted according to the existing land use (residential, commercial, industrial and recreational) and the present population density.

4) For the sub-urban areas, the population projection was made for each zone according to the existing land use (agricultural, commercial, industrial, kind of dwelling houses and water bodies) and the assessed land use in the future by taking into account the possible extension of housing, present density of population and the urbanized area neighbourhood.

5) Population projections for the target years 1995, 2000, 2010 and 2020 are given for 36 EUZs of the study area in Table 4.6.1.

(2) Per Capita Consumption

1) Domestic

The domestic consumers were divided into four categories based on the kind of dwelling houses which reflect the level of income and consequently the water consumption per inhabitant and were given the following per capita water consumption:

Poor:	slum, villages, settlements, squatters, floating people	30 lpcd
Low income:	semi-pucca, unplanned pucca, pucca housing	110 lpcd
Medium income:	planned pucca housing	170 lpcd
High income :	residential areas	240 lpcd

For each elementary zone, the average domestic per capita consumption is determined according to the proportional area occupied by each community category and weighing the water consumption accordingly.

Table 4.6.1 Population Projections for 36 EUZs under EWSP

	Elementary Urban Zone	Area (ha)	Population					
			1981	1991	1995	2000	2010	2020
1	Bailjuri	670	16,639	25,554	32,567	43,582	74,444	121,261
2	Uttara	673	8,568	31,740	48,184	77,600	175,453	375,296
3	Uttar Khan	1,718	18,039	27,187	37,331	53,594	107,917	212,288
4	Digun	700	700	983	1,439	2,318	6,581	18,687
5	Bhasantek	783	7,063	9,900	12,617	16,884	33,214	62,347
6	Dakshinkhan	1,133	23,639	58,946	80,941	116,201	233,981	471,145
7	Mirpur	870	80,227	204,739	258,478	322,111	422,497	527,785
8	Pollabi	610	113,210	288,912	332,816	385,825	456,668	494,545
9	Damalkot	835	37,185	59,532	70,181	84,569	118,145	161,887
10	Khilkhet	645	18,828	34,005	43,256	58,710	110,207	208,824
11	Paikpara	1,625	131,122	334,623	422,454	539,170	782,887	982,778
12	Gulshan Banani	1,123	105,763	130,111	164,262	223,999	420,476	622,408
13	Badda	583	16,125	43,257	57,768	81,023	156,431	307,723
14	Mohammadpur	480	153,229	246,441	282,797	327,839	411,545	450,120
15	Shara Bangla Nagar	493	66,479	125,971	143,997	166,932	205,493	236,143
16	Dhanmondi	323	93,151	158,860	177,069	200,337	251,488	280,562
17	Tejgaon	768	190,012	393,007	449,244	520,797	578,138	629,202
18	Khilgaon Gora	1,003	195,368	404,084	491,167	569,397	641,535	705,153
19	Nandipara	1,708	30,497	50,400	61,965	80,985	145,032	272,246
20	Lalbagh	428	238,286	322,606	345,109	369,952	410,685	436,002
21	Ramna	735	202,344	288,750	308,891	332,764	367,578	402,033
22	Motijheel	325	77,884	113,374	121,760	131,170	143,465	154,596
23	Manda	900	20,199	40,161	47,345	59,001	91,626	142,293
24	Kotwali Sutrap	615	405,460	455,590	479,746	506,719	554,216	597,213
25	Jatrabari	505	191,696	286,378	316,108	351,238	403,628	450,291
26	Jurain	735	59,113	129,578	145,841	167,028	211,733	267,096
27	DND area	910	10,542	37,484	60,042	92,382	218,702	517,748
28	Demra	205	11,344	37,484	57,936	81,258	120,281	164,814
29	Ailbahar	553	18,052	29,753	38,420	52,639	105,501	207,536
30	Pagla	1,448	33,516	45,000	58,546	88,033	173,175	356,918
31	Ghoshpara	890	30,028	38,000	47,974	67,286	132,362	260,376
32	Katchpur	600	45,097	66,000	81,762	109,417	215,239	385,460
33	Siddirganj	1,105	18,873	29,000	36,612	56,332	127,365	250,547
34	Fatulla	403	12,169	16,000	19,972	26,727	55,085	98,649
35	Godnail	443	40,918	60,000	74,329	97,607	151,581	213,819
36	Narayanganj	955	156,815	192,977	239,065	316,916	447,041	572,250
	Total Survey Area	28,498	2,878,180	4,816,387	5,647,991	6,778,340	9,261,394	12,618,042
	Dhaka City		2,273,357	3,804,140	4,355,216	5,025,655	6,174,268	7,172,236
	Narayanganj		197,733	252,977	313,394	414,523	598,621	786,069
	Suburban Area North		120,615	246,888	330,258	465,427	902,990	1,749,409
	Suburban Area South		286,474	512,381	649,123	872,736	1,585,515	2,910,328

	Sub-total of EUZ 1 to 13	11,968	577,108	1,249,489	1,562,294	2,005,586	3,098,901	4,566,974

Dhaka City : Zones 7, 8, 9(40%), 10(10%), 11, 12, 14 to 18, 20 to 22, 24 and 25

Narayanganj : 35 and 36

Suburban Area North : 1 to 6, 9(60%), 10(40%) and 13

Suburban Area South : 19, 23 and 26 to 34

Note: The area of EUZs 1 to 13 approximately equals to the study area for the North Dhaka Sewerage Development

2) Commercial (Urban Service)

The per capita consumption is adjusted according to the density of the urban service in each elementary zone.

High density of urban service	20 lpcd
Medium density of urban service	15 lpcd
Low density of urban service	10 lpcd

3) Industrial

The per capita consumption is adjusted according to the density of the industries in each elementary zone.

High density of industries	25 lpcd
Medium density of industries	18 lpcd
Low density of industries	10 lpcd

(3) Methodology for Water Demand Projection

The following methodology was applied to project the future water demand:

1) Estimate the proportion of the different kinds of land use in each of the 36 elementary urban zones in the study area. The following categories of land use are considered:
   - domestic : poor, low, medium, high income;
   - commercial (urban service); and
   - industrial.

2) Assess the 1991 total water demand per elementary urban zone according to the proportion of the different categories of land use and their respective per capita water demand. The consumption of the main types of consumers are then summated - domestic, industrial, commercial and urban services.

3) Assess the water consumption for the target years. It is assumed that:
   - the per capita demand per category of consumers will not increase with time;
   - progressively, with the development of the country and of the city , the standard of living will increase and people will raise to higher categories of consumers;

- the number of people having access to the distribution system will increase with time. In the target year 2020, it is expected that 80% of the total population of the study area will have a direct connection.

Projection of the total water consumption is made on the basis of a projection of the future land use and population.

4) Calculation of the total water supply requirement is developed by taking into account a dry season daily peak of 10% and the physical losses on the distribution network. A loss of 35% is taken for 1991, with the assumption that the distribution network will be upgraded and the water losses will decrease. The following evolution of the physical losses is used:

1991	35% losses
1995	31%
2000	28%
2010	20%
2020	15%

The study also examined the potential surface water sources.

The water demand analysis indicated for the study area a total requirement of 2.48 million cu.m/day by the year 2020 with improvement in waste control. DWASA at present produces 0.6 million cu.m/day. New drilled tubewells, which were waiting connection to the distribution system, would produce additional 0.1 million cu.m/day. To produce the additional requirement and to define a long-term development scheme for the water supply of Dhaka City, the possibility to have resources to regional surface water resources had been also analyzed so to investigate the most reasonable combination of surface and groundwater exploitation.

The six location sites (see Figure 4.6.2) selected with the general viability of surface water development were examined on the relative proximity to the area to supply and reliable quantity, quality and treatability of the available resources.

Site 1 Intake on the Lakhya River at Demra and treatment plant at Saidabad

Site 2 Intake and treatment plant at Friendship Bridge on the Buriganga River

Site 3 Intake and treatment plant at Kamrangir on the Buriganga River

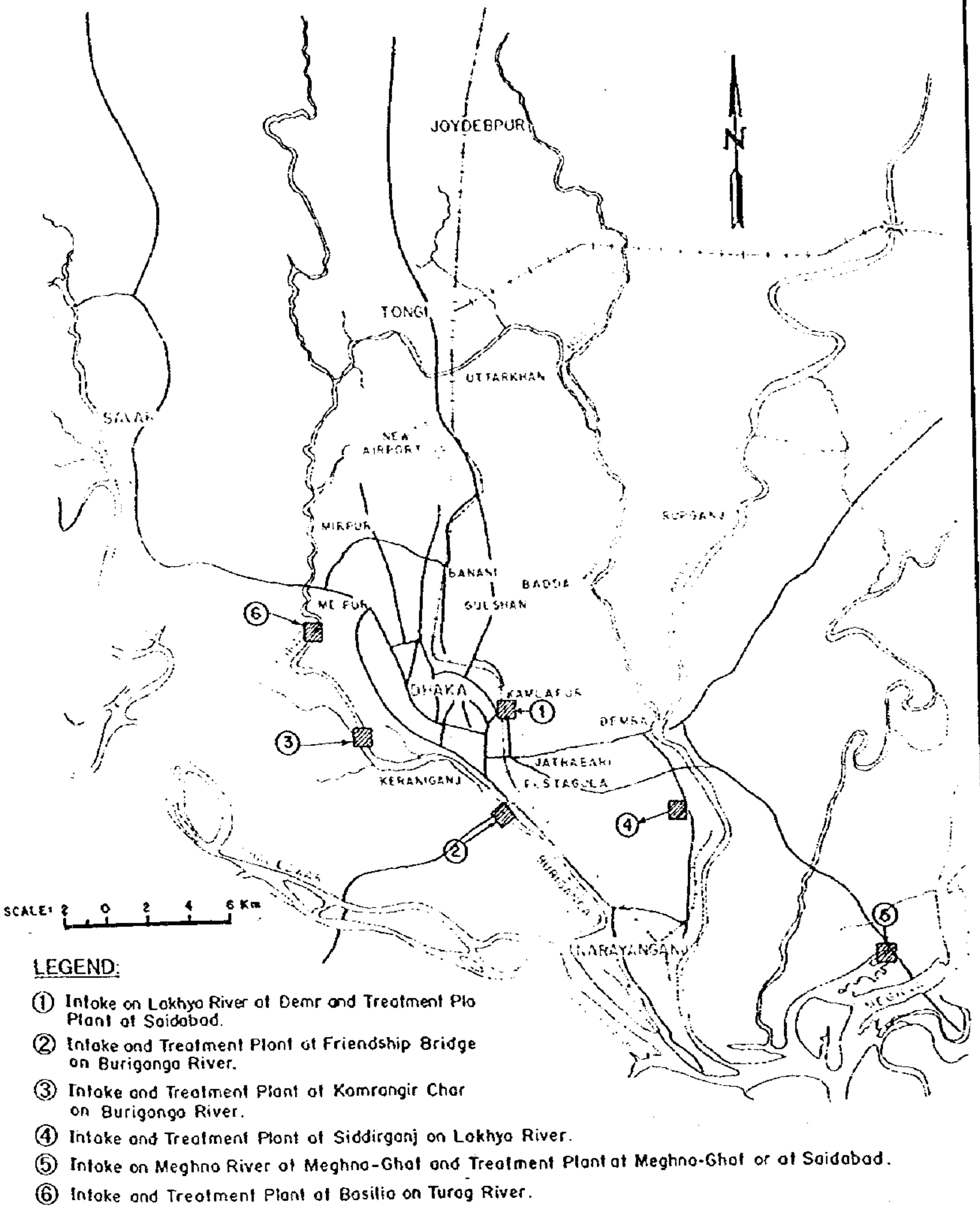


Figure 4.6.2

Potential Surface Water Intake Sites under EWSP

The Study on the Sewerage System in North Dhaka

Site 4 Intake and treatment plant at Siddirganj on the Lakhya River

Site 5 Intake on the Meghna River at Megnha-Ghat and treatment plant at Megnha-Ghat or at Saidabad

Site 6 Intake and treatment plant at Basilia on the Turag River

Sites 5 and 6 were eliminated through preliminary screening due to the high construction cost for water transmission facilities from the intake site to Dhaka City and the unavailability of water during the dry season, respectively. Sites 1 and 2 were finally selected through various evaluations including anenvironmental impact assessment. Figure 4.6.3 shows the proposed long-term surface water development plan on the basis of least cost.

4.7 Staff Appraisal Report (Report No. 13969-BD), "Bangladesh Fourth Dhaka Water Supply Project", The World Bank, November 1996

The Fourth Dhaka Water Supply Project (DWASA IV) consists of the following major components:

- institutional reform program,
- capacity additions and service extension,
- loss reduction, sanitation and efficiency improvement activities, and
- institutional development technical assistance.

The third component includes a sanitation program consisting of a study and preparation of a sanitation master plan for Dhaka for the period 1995-2010, and first stage investments in low cost sanitation and rehabilitation of selected sewerage systems assets. The term "sanitation" is defined here as a service: (a) for the collection and disposal of excreta and wastewater from domestic, commercial and industrial sources and (b) for the abatement of environmental pollution from such waste. The provision of this service entails the construction, operation and maintenance of a range of physical infrastructures, such as conventional sewerage, intermediate sewerage and various type of on-site sanitation systems. Although the consultants' selection procedure has not yet been commenced as the end of May 1997, its scope of work as presented in Annex 4.1 "Draft Outline Terms of Reference for Feasibility Study for Improvement Sanitation Services" is almost the same as that of the JICA Study except for the difference in the study area and some of the items to be studied.

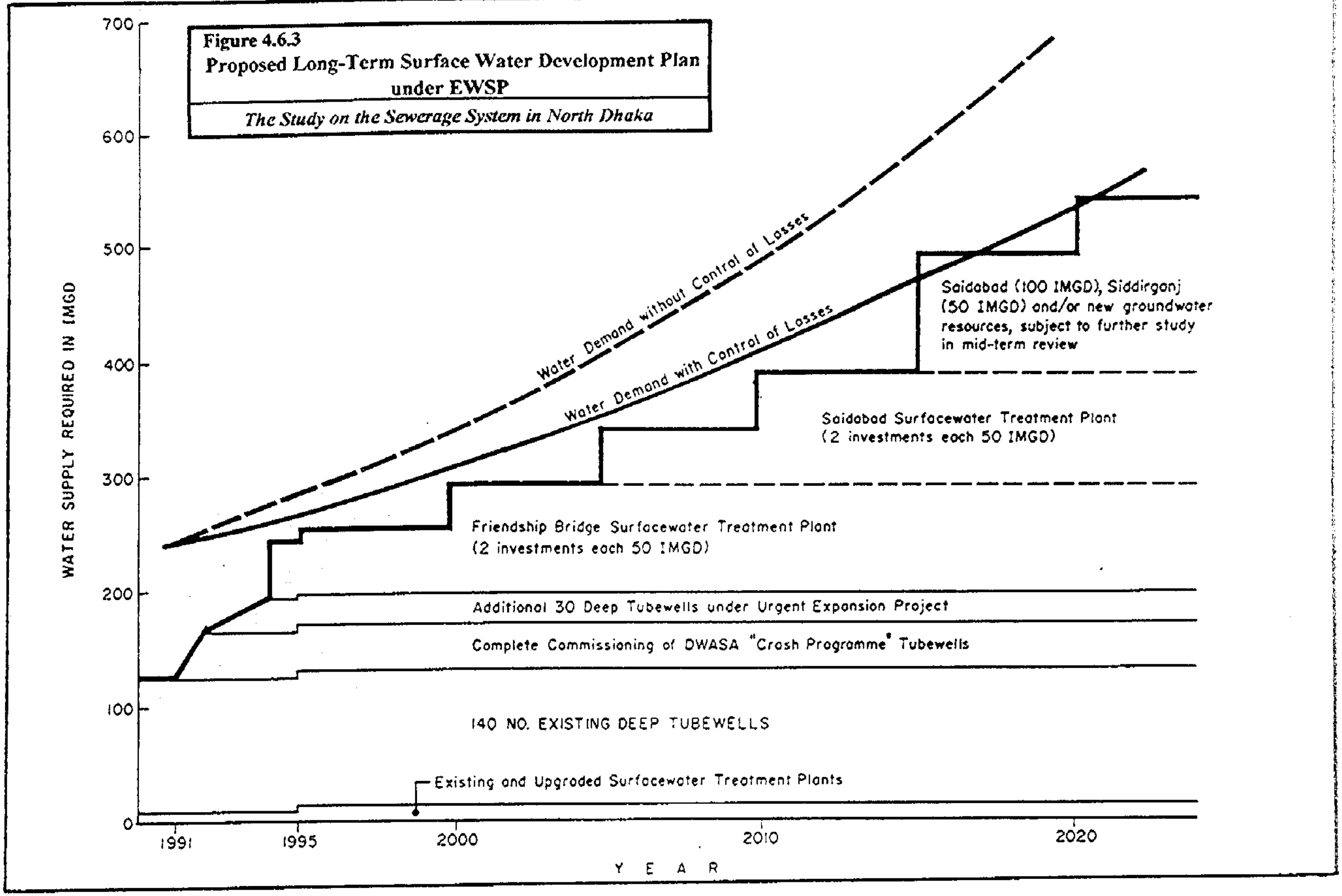


Figure 4.6.3
Proposed Long-Term Surface Water Development Plan under EWSP

The Study on the Sewerage System in North Dhaka

The study area is limited to North Dhaka including a part of Tongi within the Statistical Metropolitan Area (SMA) in the JICA Study, while to Dhaka City in DWASA IV, however, the JICA Study also includes the review on the existing sewerage system in South Dhaka.

It should be noted that DWASA IV is in principle based on the population projection for the SMA (excluding Tongi) up to the year 2020 as shown in Table 4.6.1, which was made in the Dhaka City Emergency Water Supply Project in 1992 as mentioned above.

CHAPTER 5

PRESENT STATUS IN NORTH DHAKA

CHAPTER 5 PRESENT STATUS IN NORTH DHAKA

5.1 Population

(1) Present Population

The rapid increases in the population of Dhaka began in 1947 when the City of Dhaka was chosen as the capital of erstwhile East Pakistan. A large number of Muslim immigrants from India moved to the new capital which resulted in a sharp increase in the population of the city. This increase of population was further accelerated by the movement of the people to the city from other parts of the country.

According to the population census conducted in 1991 the population of the Dhaka metropolitan area was 3,804,140 and the population of the Study Area was estimated at 131,237. Recently, developed urban areas such as Uttara and Tongi have had an influx of immigrants from the rural areas since 1980 and the population of metro Dhaka has rapidly increased

The study area can divided into several residential zones by population density. Of these zones, the less populated areas could be regarded as Gulshan, Banani and Baridhara. The densely populated areas are Tongi, Uttara, Badda, Cantonment, Mohamedpur and Mirpur. From a global point of view, Bangladesh is the second most densely populated nation in the world after Singapore. The population density in 1984 was 657 persons per sq.km (1,701 persons per sq.mile) for the country as a whole and now this figure increased to 755 persons/sq.km in 1991. If the arable and populated areas are considered separately, the density rises to over 1,648 persons per sq.km (4,112 persons per sq.mile). Table 5.1.1 shows the breakdown and the projected population growth within metro Dhaka.

Along with its rising size, the population growing is growing younger. Nearly 45.7% were believed to be under 14 in 1975, up from 45% in 1970. Those between 15 and 64 account for around 51.2% of the population and those over 65 for 3.1%. In the 1991 census the male and female ratio was 106 males per 100 females.

(2) Internal migration from rural to urban areas

The urban component of the population is not only one of the smallest in the world at 20.1% but has remained relatively stable with little increase over 1984 at 11.7%. The giant cities of the developing world are growing faster than the cities in the developed world have ever done. One reason for this is population increase, the other reason is the migration of people from rural areas to towns and cities.

Different forces combine to cause people to migrate to cities. There are forces which push people from their land and others which pull them towards the cities. Some of the push factors are the difficulty of making a living in the rural areas, poor land or landlessness, lack of jobs, loss of land which have been washed away by river erosion, etc.

Because of the people are so poor, they have to squat on the poorest land which is unfit for housing. It may suffer from overcrowded existing housing, be situated on low land, next to polluting industries or waste dumps. Often there are no services--water, electricity, refuse collection or sewer--but the people have no where else to go. Often they are resourceful and can improve their settlements over time, but the pressure of the new arrivals make lasting improvements difficult. Nearly 42% of Dhaka's population lives in slums and squatter settlements.

5.2 Industry

Although Bangladesh is predominantly a agricultural country, a large number of large-scale industries based on both indigenous and imported raw materials have been set up. Among them jute and cotton textile, paper and newsprint, sugar, chemicals cement, fertiliser and tanneries are important. Dhaka, however, a long tradition in the field of industry. The finest Dhaka Muslin cloth of exquisite delicacy, which was produced during the period of the Mughal, still remains a great wonder to cotton experts

Industry (including mining, manufacturing, power and construction) employed 15.4% of the working population in 1989, and contributed 16.6% of total GDP in 1991/92. During 1980-92 industrial GDP increased by an annual average of 5.1%. Industrial production rose by 8.6% in 1992/93. To further promote industrialisation, the Government of Bangladesh has taken several efforts by setting up special efforts by setting up special Export Processing Zones (EPZs) to encourage and accelerate the countries industrialisation both for local and foreign investors providing with full facilities.

Even though the problems of Bangladesh are manifold, in view of widespread poverty malnutrition and under employment superimposed on a rapidly increasing population and a poor resource base--quite remarkable achievements have been made in the field of export promotion. This is especially true in non-traditional items (notably in the cotton garments sector) which accounted for 51% of export revenues in the year 1990/91.

A radial change took place in the process of industrialisation in and around the city of Dhaka with the creation of Bangladesh in 1971. Many more industrial enterprises of different sizes and categories were established and the old ones were remodelled to meet the requirements of the new state.

In the Study Area, a remarkable development has taken place in the Tongi industrial area. This area is particularly famous for cotton mills, shoe factories, telephone industry, pulp and paper industries, multinational pharmaceutical companies, etc. On a smaller scale, the city of Dhaka maintains a healthy number of cottage industries. Articles like handloom cloth, pottery, bangles, ring and conch-shells (sanka) are the main products of the cottage industries of the city. These industries contributed 16.6% of the total GDP in 1991/92. In addition, factories and workshops of different natures are found all over the Study Area. The main factories include engineering workshops, printing press, tanneries, metal works, saw mills, oil mills, bakeries etc.

5.3 Land Use

A comprehensive analysis over the status of land use and urban planning in Dhaka and the surrounding areas, which are the more recently reviewed data (contained in the JICA FAP-8A Interim Report of March 1991), provides an in-depth review of the historical growth of Dhaka City. The result of a land use survey conducted by the JICA Study Team and their forecast of the probable patterns and growth rates in Dhaka up to the year 2000 are shown below.

Table 5.3.1 Projected Population and Land Use in Metro Dhaka

Area	Population ('000)				Land Use in Built-up Areas (ha)		
	1990	2000	2010	Total	1990	2000	2010
High established area	188	252	285	1,072	1,072	1,072	1,072
West Embankment	312	524	587	1,043	330	627	627
Old Dhaka	1,266	1778	1,778	1,166	1,142	1,156	1,156
Com/Ind/Inst. Area	514	775	861	1,893	1,759	1,807	1,807
Eastern Dhaka	968	1,447	1,617	2,044	1,715	2,044	2,044
Mirpur area	669	1,283	1,608	5,653	1,732	2,595	3,300
Other central area	294	305	345	370	312	357	357
Cantonment	162	238	322	3,175	1,717	1,943	2,023
Eastern Embankment	292	530	1,300	10,100	1,642	2,422	5,325
Greater Dhaka	4,565	7,132	8,703	26,516	1,421	14,023	17,711
Total				100%	43%	53%	67%
Average Growth Rates	4.6%	2.0%		2.1%	2.4%		

The notable features of the land use observed by the JICA FAP-8A Study Team were:

- Compared to the residential use and the population served, the proportion of land for park, roads, commercial uses and for industries are too low.
- One third of the city's population, living in the wide scattering of very poor slum and squatter settlements, hold very small areas.
- Upper income group holds large area for their housing.
- Population density remains high, particularly in the slum and squatter settlements.

The other major relevant observations extracted from the JICA report can be summarised as follows:

- During the period from 1980 to 1990, the greater Dhaka average population growth rate rose 5.5% from about 2.8 million to 4.6 million people and at the same time the built up area increased from 104 sq.km to 114 sq.km (39% of city area to 43%)

- For 1991, it was estimated that the population of greater Dhaka is about 4.8 million, and adding another 2.2 million from its surrounding, for a total Dhaka conurbation population of about 7.0 million.
- Total land use in Dhaka, with an area of 265 sq.km (1990), which holdings for residential use 5,320 ha or 8%, roads and others 2,930 ha or 11%, village settlement 1,110 ha or 4%, agriculture 12,370 ha or 45% and water bodies 13,430 ha or 12%, 39% of the total land was in urban use, while 61% for rural or semi-rural.

All of this reflects an intensity of land use brought about by increasing population pressure, limited alternative development areas and the lack of the transportation system which would allow a more extensive development pattern.

It is estimated that the growth rate for Dhaka will diminish in the coming years, to an average of 4.6% from 1990-2000, and 2.0% between 2000-2010, resulting in populations of 7.1 million in 2000, and 8.7 million in 2010.

Much of this growth will absorbed by increased densification in existing developed area and the demand for new land for development will grow at a lower rate averaging about 2.2% for the period up to 2010. In spite of this, however it is estimated that the built-up area will increase from its 1990 level of 114 sq.km, to 177 sq.km (43% to 67%) over the 20 year period.

The major growth pressure will occur along the perimeter of existing built-up areas, in what are now marginal lands. The main demands for new development areas are expected to take place in the west embankment, eastern Dhaka, Mirpur and the Eastern Embankment areas, on what are now agricultural lands.

The proportion of low-income slum and squatter dwellers will probably increase in proportion to their present ratio of 30% of the total population.

Land use planing in Dhaka is still primarily guided by the master plan developed in 1959/60 under the technical cooperation scheme of the Colombo Plan. Although this plan was developed for only a 20-year planing horizon up to 1978, up until 1994 there were no major revisions to the master plan since it was prepared, and minor modifications have been made on an ad-hoc basis.

Most of the land use planning in Dhaka is an informal exercise, responsive to the existence/provision of the major public infrastructure expansions which have been guided by the 1959/60 master plan, and by market forces.

5.4 Social Infrastructure

5.4.1 Water Supply

The water supply coverage of the Study Area varies according to source. To evaluate this parameter various documents were examined. Their source and findings are as follows:

Documents	Population Served
4th plan 1990 to 1995, draft report	65%
Metropolitan development plan (UNCHS)	58%
Survey performed in 1995 (Social formation in Dhaka,1980)	60%

The total estimated water production capacity was 192 IMGD. In terms of actual water volume supplied, DWASA information indicates that it has an estimated 161,185 connections. However, this number is open to question as there are a large number of illegal connections. The unaccounted for water (UFW) ratio is officially 47% but it is most likely higher.

The vast majority (95%) of the water supplied to Dhaka by DWASA comes from groundwater sources, which are comprised of some 190 tubewells. This water varies in quality and suffers from an ill-maintained disinfection program. There are also a significant number of private tubewells in the Study Area but the exact numbers are unknown due to the owner's reluctance to pay the fees to DWASA for any such facilities.

Within Dhaka, the availability of water fluctuates depending on the area. In the Study Area, the areas with more income, Gulshan for example, have relatively good supply in terms of quantity and quality while the lower income areas such as Mirpur have poor availability and quality. Most of this can be attributed to the present condition of the distribution systems in those areas.

5.4.2 Sewerage

(1) Existing sewerage system

Dhaka contains a municipal sewerage collection and treatment system which dates backs to the early 1920's and has seen periodic expansions in conjunction with the growth of the community. Currently the system extends over approximately 50 sq.km or about 20% of Dhaka and consists of a network of 440 km of sewer mains, trunk lines and interceptor ranging in size from 200 to 1,360 mm, plus 15 sewage lift stations. The sewers are constructed of a range of materials, including mild steel, asbestos concrete, PVC, ductile iron and brick, many of which are seriously deteriorated. Infiltration rates are high, many of the manholes are damaged and sewers are blocked. Pump station failure, system surcharging and sewage overflows are common during the monsoon season.

The per capita sewage flow varies depending upon the DWASA service zone. Based upon the 1990 JICA design study report, the range is from 56 to 102 lpcd. Currently there are 40,970 sewer connections representing coverage of 29% of the registered holdings or about 15% to 20% of the greater Dhaka population. According to DWASA, the existing sewerage collection network is currently operating near its maximum capacity. Dry season flows total about 75 MLD, and wet season flows equal the system capacity of about 120 MLD. Further opportunities for expanding the service within the existing network are very limited. Unless the system is expanded, infiltration rates are reduced, or further connections are limited, the system will become overloaded within the next few years, resulting in the flooding of sewerage throughout the city. Effluent is transported to a single primary treatment plant at Pagla, which has recently been rehabilitated and expanded with JICA's assistance.

The Pagla sewer treatment plant with a 40 IMGD (2.1 cu.m/day), serves 38,950 connections with a 450 km network. The system is insufficient to cope with the present requirements, with only about 40% of the city's wastewater being treated. Apart from some disposal in septic tanks, most of the remainder is discharged to low lying areas, surface drains or water courses.

Some 70% of the 1,339,430 recorded households have sanitary latrines (BBS, 1992), some of which are connected to septic tanks in areas not served by the sewerage system.. Of the remaining households, 20% have other latrines (pit latrines, etc.) 30% have no latrine facilities at all. The existing sewerage system have to cope with a lot of problems, including:

- blockage caused by disposal of solid wastes into the sewers through manholes and unauthorised connections;
- theoretical overloading in the old city area, although the numerous leaks in the system effectively prevents major overflows; and
- from industry discharging of toxic effluent.

At the Pagla treatment plant, the have been problem discharges as the effluent is not pre-treated before being discharged from the industrial sources. Prosecution threats by DWASA have resulted in the diversion of some of effluent to surface drains (Khan,1993).

Many of the existing pumping stations and sewers are presently running at close to their design capacity with several instances where they have already been well exceeded. In the next few years, all the stations and sewers will become overloaded and major sewage flooding can be expected.

(2) Small Bore System in Mirpur

In case of Mirpur, some areas are served by Small Bore Sewerage System. Service area covers the residential area and divided into seven areas.

Based on the inspection of the design drawings, the following informations were figured out :

- Number of connected households 16,806 HH
- Design service area 506.890 ha
- Diameter of sewers ϕ 100～400 mm
- Total length of sewer 71,800 m
- Number of septic tanks 830

Areas are seemed to be divided by every 2,500 HH approximately.

Upon site survey on the existing facilities, conditions on connections to septic tanks, sewer installation, effluent receiving bodies were examined, however, confirmation of the whole system was difficult due to the presence of squatting area. As of now, only nightsoil is connected to the system and domestic sewage is discharged to channels nearby without any treatment. Effluent from septic tank is also discharged to the surrounding ponds untreated.

The existing septic tanks need proper maintenance, since their treatment capacity is very low.

Further, the effluent is discharged to the receiving bodies by the following three methods :

- Pumping
- Discharge through the gates (gravity flow)
- Direct discharge by gravity flow

For detailed information, please refer to Appendix 5.4.1.

The estimated capacity of sewer in Small Bore System is shown in Table 5.4.1. Based on the design drawings, sewer capacity was estimated by pipe diameter and slope at the effluent points of the said seven areas. Design sewage flow was also calculated by the area of sewerage zone, population density and per capita sewage flow which was established in the sewerage master plan.

Though, these existing sewers in the system are used exclusively for the effluent from septic tanks at present, this estimation shows that they can cope with the design daily maximum sewage flow, even with the hourly maximum sewage flow almost.

Table 5.4.1 Estimated Sewer Capacity of Small Bore Sewerage System in Mirpur

Zone		Area	Population	Design Sewage Flow		Sewer Capacity at the Effluent Points				Sewer Capacity per Design Sewage Flow	
				Daily Max.	Hourly Max.	Dia.	Gradient	Flow Vilocity	Flow Rate		
		(ha)	(person)	(cu.m/sec)		(mm)	(‰)	(m/s)	(cu.m/s)	Daily Max.	Hourly Max.
1		42.9	23,000	0.0333	0.0426	300	1.4	0.67	0.047	1.4	1.1
2	A	48.5	26,000	0.0376	0.0481	300	2.0	0.80	0.057	1.5	1.2
	B	15.3	8,000	0.0116	0.0148	200	3.0	0.74	0.023	2.0	1.6
	C	4.5	2,000	0.0029	0.0037	200	2.5	0.68	0.021	7.2	5.7
	D	34.2	19,000	0.0275	0.0352	300	2.0	0.80	0.057	2.1	1.6
3	A	17.3	9,000	0.0130	0.0167	200	2.0	0.61	0.019	1.5	1.1
	B	23.8	13,000	0.0188	0.0241	200	2.0	0.61	0.019	1.0	0.8
	C	3.0	2,000	0.0029	0.0037	150	5.0	0.79	0.014	4.8	3.8
4		135.9	74,000	0.1071	0.1370	400	2.0	0.96	0.121	1.1	0.9
5		109.2	59,000	0.0854	0.1093	300	1.5	0.69	0.049	1.1	0.9
						300	1.5	0.69	0.049		
6		20.2	11,000	0.0159	0.0204	300	2.5	0.89	0.063	4.0	3.1
7		52.0	28,000	0.0405	0.0519	300	2.5	0.89	0.063	1.6	1.2

Note: Population Density: 541 person/ha
Per Capita Sewage Flow: Daily Max.- 125 l/capita·day
Hourly Max.- 160 l/capita·day
Kind of Sewers: Polyvinyl Chloride Pipes
Roughness Coefficient: 0.010

There are 830 septic tanks in Mirpur. Large-scale tanks (600 and 800-person) are also installed and their number is 27 and 33 units respectively. According to the design drawings, dimension and effective volume of these tanks are shown in Table 5.4.2.

Table 5.4.2 Effective Volume of Septic Tank in Small Bore Sewerage System

Type	Dimension (mm)			Effective Volume (cu.m)	Volume of Settling Cell in Japanese Septic Tank (cu.m)
	Length	Width	Depth		
A (800-person)	9000	3000	2400	64.8	72.3
B (600-person)	8250	2750	2450	55.6	54.3

Compared with the Japanese septic tank structural standard, these effective volume correspond to that of sedimentation chamber of nightsoil septic tank and the SS removal rate can be assumed at roughly 50% if settled sludge is removed every six months. Consequently, the SS concentration of the effluent from septic tank will be 200 mg/l approximately.

Nightsoil volume : 50 l/capita.day

SS contained in night soil : 21 g/capita.day

SS removal rate of septic tank : 50 %

SS concentration of septic tank effluent : 21 g/capita.day × 50 % ÷ 50 l/capita.day

≒ 200 mg/l

This effluent quality is not favourable as effluent to public water bodies. Further, this figure might be increase in future since the proper maintenance, such as periodical sludge removal, is not conducted at present. Additional secondary treatment by aeration is not applicable due to volumetric restriction.

Accordingly, utilising the existing septic tanks and sewers, installation of temporary secondary treatment facility for the septic tank effluent is recommendable as a phased sewerage development plan until the whole system is connected to the sewage treatment plant. The said secondary treatment plant could be installed at the effluent points of the seven zones or in other suitable site/s integrating effluent from plural zones by additional collection trunk sewers.

5.4.3 Sanitation

(1) Overview of existing sanitation conditions

The release of pollutants into the environment constitutes an extremely serious health hazard to Dhaka residents, particularly for the urban poor who rely extensively on open water bodies for daily use and who are most directly effected during the rainy season and the accompanying flooding.

The health conditions of the urban slums are quite bad, and at any given time 30% to 46% of the population suffers from disease. Most of the diseases are related to environmental conditions--particularly from the water and air pollution. The crude death rate for urban slums is 42.62 per thousand (highest), which is four times the national average and six times the urban non-slum average. The infant mortality rate is 152 to 180 per thousand, over 50% higher than the national norm and almost double the urban non-slum rate.

Within the urban portion of the greater Dhaka area, which covers approximately 10,630 ha, or 39% of the total city area (Greater Dhaka Flood Protection Project-FAP-8A, Interim Report, JICA, 1991) the problems of poverty, heavily concentrated populations, low levels of public awareness, and inadequate environmental control system have inevitably led to escalating pollution levels of both the immediate urban environment and the water bodies in and around Dhaka. Inadequate sanitation and excreta management services, uncontrolled discharges of household and industrial wastes to the open drain and khal systems, and inadequate solid waste management services have all contributed towards creating the problem. A lack of clear policies on urban development issues, inadequate control mechanisms and resources and low communal awareness are contributing towards perpetuating the situation.

(2) Sanitation system

Accurate information on the existing sanitation situation in Dhaka is not readily available, but based on a comparison of estimates quoted in the task force recommendations, the JICA Interim Report, and the 1988 (slums and squatters in Dhaka - a survey conducted for the DMC, by the Centre for Urban Studies, June 1988) study on the urban poor, it is estimated that only approximately 15% to 20% of the city population of 4.8 million is currently served by the DWASA sewer and sewage treatment system. Of the remainder, 25% are serviced by on-site septic tanks, 15% by sanitary pit latrines, and 5% by bucket latrines. The remaining 35% to 40%, representing some 1.8 million people, are serviced by unsanitary systems, consisting mainly to kutcha latrines and open defecation which deposits human wastes directly into the local living environment.

1) City sewage system

The existing trunk sewerage system which covers the central development area of Dhaka comprises three trunk interceptor sewer lines which together at the head of the Pagla sewer to discharge by gravity to the treatment plant.

The sewerage system covers some 38% of the Dhaka city corporation area, leaving large areas in the north of the city without sewerage, although surface water and storm drains are provided. The sewerage system is designed for theoretical flows related to water supply requirements rather than the lower volumes actually supplied and so in general has surplus capacity except in the old city.

2) Other sanitation systems

Households not connected to the city sewerage collection system depend upon one of two general categories of disposal systems located on the property site. The first category consists of in-ground sanitary disposal systems, including septic tanks, which service about 25% of the population, or more basic pit latrines which about 15%. The second category consists of unsanitary systems which deposit human waste to the ground surface or adjacent water body, including kutcha (which use no brick/cement) latrines and open defecation. This latter system covers about 35% to 40% of the total population, and used extensively by residents of slums and squatter settlements. Bucket latrines, where waste is collected and disposed off site, cover about 5% of the population (mainly in congested older areas and in accordance with government policy are being phased out).

More of the system, nominally regarded as being sanitary systems are, however, also active sources of pollution due to improper installation or improper operation and maintenance. Septic tank effluent frequently is discharged into the local storm drainage systems; pit latrines overflow during wet periods; wastes collected from bucket latrines and sludge collected by private septic tank cleaning services are deposited into local lowlands, and drains and khals.

3) Communal facilities

Public sanitary facilities are constructed by the DCC and there are currently about 20 public toilets located within Dhaka City, another 4/5 toilets are located in the study area in Uttara and Tongi, the majority of which are in densely populated areas within old Dhaka. The public toilets provide the general population with access to toilets, wash basins and bathing rooms and are connected to the city water and sewerage systems. A nominal fee of 50 Paisa (0.50 Taka) to one Taka (1US$ = 44 Taka) is charged depending on the service provided.

5.4.4 Drainage

Storm water drains in Dhaka presently consist of around 134 km of pipe with diameters ranging from 450 to 3,000 mm. A pumping station with a capacity 182 IMGD (9.6 cu.m/s), which discharges storm water into the Buriganga River, is located at Narinda near the Jatrabari road junction; and a further station at Kallyanpur which discharges into the Turag River west of Dhaka. In addition to this formal drainage system, some 13 major and 9 minor drainage canals (khals) totalling the area of 80 km from an important part of the city's drainage network, but suffer from little or no maintenance. Many are partially or completely blocked by refuse or unauthorised land fills and illegal constructions. Apart from the chemical effluent noted above, raw sewage also flows into the drainage system.

The surface water drainage system is unable to cope with peak drainage requirements and surface waterlogging is a problem in some areas during the monsoon season and for a period afterwards as the flood waters subside.

The three main canals (khal) systems are covered below, which are particularly important for the DWASA IV project:

(1) Dholai Khal

The Gerani Khal flows south-westward from near the Saidabad SWTP sites and joins and joins the Debdulai khal south of the Jatrabari on from the Dholai khal which flows to a pumping station on the Buriganga River.

(2) Begunbari/Gojaria khal system

The Begunbari Khal (at present the subject of culvert construction from the middle of the Dhaka to the Rampura bridge) drains central Dhaka and the Tejgaon industrial area north-eastward; it is joined by drains from north-eastern Dhaka and becomes the Gojaria khal which flows eastward to the Balu River.

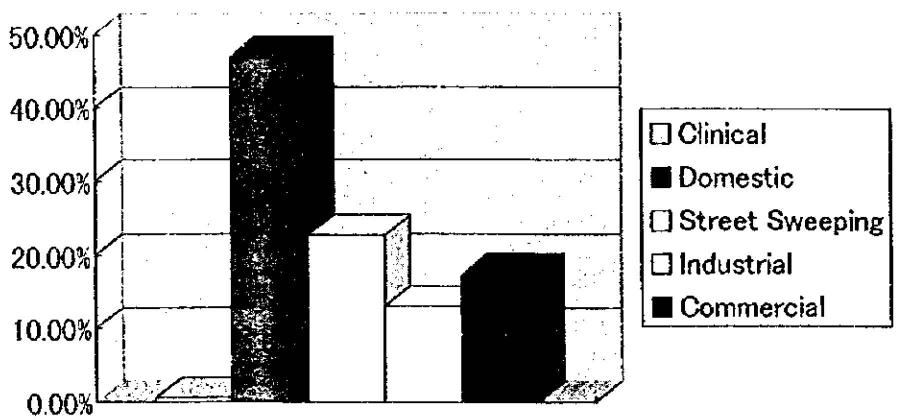
(3) Berayet Khal

The Berayet Khal drains the land north of the Begunbari/Gojaria khals into the Balu River. In the study area in Uttara and Tongi, storm water falls out through drainage system to the nearby lake and into the Tongi River.

5.4.5 Solid Waste Management

During the 1985-91 period, solid waste generation in Dhaka increased from 1,050 tons/day to 1,782 tons/day (UNDP, 1985. More than half of the city's daily generated solid wastes remain uncollected and are being disposed of locally, which causes huge environmental hazards. Figure 5.4.1 Shows the breakdown of the solid waste in Dhaka.

Figure 5.4.1 Waste Composition of Dhaka City & Study Area



According to the DCC, the total solid waste generated per day is estimated around 3,000 tons, considering an urban population of six million.

The larger quantity of organic contents presents in Dhaka's waste composition indicates the necessity for frequent collection and removal. In total, 4,221 cleaners are engaged by the DCC for cleaning the city. The DCC provides two types of dustbins; one made of CI sheet and another of masonry construction. Recently it has introduced dismountable containers as a pilot scheme in some parts of the city. At present there 2,450 CI sheet and 1,595 masonry dustbins in the city.

The DCC has 159 trucks for the collection of solid waste. These trucks make two trips per day, though 30-40% of these trucks are out of order most of the time.

The final disposal of solid wastes is being done by uncontrolled crude dumping in low-lying land or water ponds. The present disposal site is located at Jatrabari. This site is approximately 70% filled. The DCC has proposed a new sanitary landfill site at Matwail.

Management of solid waste in Dhaka city is the sole responsibility of the DCC. The area under its jurisdiction is 344 sq.km with a population of 3,583,000 (BBS, 1993).

The DCC's allocation for solid waste management in the 1993-94 budget was Tk 118,032,583. In the same period, the DCC has collected a conservancy tax of Tk 80,013,428; a shortfall of 47.51% between revenue earned and expenditure. The problems so far encountered in solid waste management are varied and are outlined below:

- Lack of finance and insufficient tax collection;
- Lack of manpower and infrastructure;
- Incomplete and insufficient collection and disposal system;
- Improper design of communal bins.

It is to be mentioned that the major concern of the project is the unauthorised dumping of the refuse in the khals (canals) and surface water bodies, which contaminates both the surface and groundwater, causing environmental hazards.

5.5 Living Environment

Problems such as over population, extreme poverty, illiteracy, deforestation, erosion, pollution and energy wastage don't only affect natural systems, but have also severe economic and social consequences in the living environment. Especially in developing countries, serious economic and social problems have arisen, leading to natural resource degradation and depletion, and to environmental pollution from industrialisation and urbanisation.

Air Pollution

Gone are the days when Dhaka was called a green city. Today the overcrowded metropolis, its population growing every minute, is billed as one of the most polluted cities in the world. Its environment is being tainted constantly by the emission of lead and carbon monoxide from motorised transport-from auto-rikshaws to tempos and cars to trucks. Dhaka's air has the highest concentration of lead among the cities known for dangerous level of air pollution during low rain periods. Also, carbon monoxide and sulphur in air have far exceeded the tolerable limits.

The problem related to the transport sector affects everyone in Dhaka. Private cars, ramshackle buses, two-stroke scooters, peddle rikshaws, and people all complete for space on the narrow and insufficient road lengths and inhale poisonous carbon gas emitted by defective vehicles. The results are health hazards, traffic congestion, traffic jams and traffic accidents.

Land Subsidence

Excessive extraction of ground water is leading to the gradual weakening of the soil. The consequences are grave. In the worst-case scenario, Dhaka will be reduced to rubble if hit by even a moderate earthquake.

The present annual ground water extraction in Dhaka exceeds the recharge rate, resulting in a gradual decline of the water table. This lowering will continue and ultimately it will invite land subsidence if the extraction continues unbridled. The warning comes in a recent study report, Effects of over withdrawal of ground water in Dhaka by the Bangladesh Water Development Board (BWDB).

The recharge to the aquifer below Dhaka occurs from the vertical percolation of rain and flood waters and by the horizontal inflow from the surrounding areas. But the rechargeable surrounding area within and around the city is decreasing by construction of building, roads and pavements etc., remaining a very little area for vertical recharge.

The situation is going to be worse due to continuous extraction of ground water with its growing demand. Other than DWASA there are also industrial and institutional sources who are exploiting ground water by installing their own deep tubewells. DWASA is planning to have about another 150 tubewells in the next five years to meet the growing demands of the city.

In 1994 and 1996, through observation of nine wells in Dhaka, it was noted that the city's groundwater table are falling every year. An observation well in Gandaria shows that the water level in January 1994 was 13.78 meters; it declined to 15.07 meters in October 1995 and further dropped in November 1996 to 15.63 meters.

Slum Areas

The environmental problems are more concentrated in the urban poor/slum areas which can't afford reasonable levels of service; hence in many cases the slum areas become sanitation messes with high public risk and these risks are carried over to the entire community. As the number of urban poor increase, so do their problems.

A million people are living in slums or as squatters on government land in Dhaka with no sanitation system for waste disposal and as a consequence, they use makeshift or open latrines. These squatter and slum dwellers expect to see one in four of their children die before the age of five, while one adult in two suffers from intestinal worms or serious respiratory infections. Infectious diseases, which are easily spread in crowded and unsanitary conditions are rampant in these areas. The squalid and cramped conditions also increase social stress and disruption--domestic abuse, rape, incest and drug use are more common among the urban poor, as are sexually transmitted diseases.

While conditions within walled compounds and homes are generally clean, the outer environment is extremely unsanitary. Open drains, ditches, and ponds are polluted by waste water, refuse and excreta. Garbage is strewn about from open dustbins awaiting collection. Cholera and typhoid outbreaks are common in the community.

The majority of the people of the city with no sewerage service depend on-site disposal. Permanent structures are either connected to the sewer line or have septic tank within their yards. Semi-pucca and kutcha houses are have pit latrines with leaching pits or makeshift latrines. Many of the present latrine facilities are unsanitary and unreliable. The disposal of excreta is wholly inadequate, and as a result the city environment is highly polluted. These intolerable conditions have a great impact on the health of the population. The economic impact of illness is equally significant.

5.6 Water Pollution

(1) Water pollution

Water pollution in the study area in North Dhaka is influenced by a number of factors: directly by discharges from sewage works and agriculture and industrial installations or from pollution incidents such as spills and indirectly from run-off (i.e. water entering into water courses from roads, industrial sites, or land which may pick up contaminants on the way and from leaching of contaminants from soil or from storage of hazardous chemicals). Pollutants originate from domestic, agricultural and industrial sources. Usually, they don't come in a pure form. Rather, the effluents derived from these sources are a complex cocktail of pollutants.

It must be stressed that, apart from cities which are sited at the north corner of the study area on the Tongi Paurashava, river water is facing pollution problems due to discharge of poorly treated sewage effluents with industrial wastes or from the overflow of sewers. Raw sewage consists of both domestic sewage (human faeces and urine, wastewater from sinks and baths) and industrial sewage (the wastewater from factories, abattoirs and hospitals. Sewage is therefore a complex mixture of organic and inorganic substances but the main constituents is water.

The suspended organic materials in raw sewage consists mainly of fats, proteins, carbohydrates (including starches and cellulose), organic acids, soaps and detergents. The dissolved organic materials consists largely of sugar, organic acids, including amino acids and detergents. Inorganic constituents includes anions (cyanide, sulphide and chloride), heavy metals (cadmium and lead) and grit.

The sewage effluent this now released to a stream near the sewage works in Pagla comprises only a few percent of the total stream discharge. With such dilution the natural stream community will decompose the remaining organic material with severe problems. However , while sewage treatment reduces the amount of organic material in the effluent discharged from the sewer works it still contain large amount of dissolved inorganic materials, such as nitrates and phosphates, which can lead to eutrophication. In addition, the effluent may also contain toxic chemicals such as heavy metals, phenols and pesticides. These may be present at extremely low concentrations, less than 1 ppm, but can still have a devastating effect on aquatic life.

(2) Pollution control in the study area

To prevent the outbreak of water borne diseases such as diarrhoea ,dysentery etc., water courses should always be kept clean and litter-free. In study area it has been observed that the water bodies became polluted via the following:

- Pathogenic organisms (bacteria, virus, protozoa and so on)
- Biodegradable organic wastes (domestic sewage, animal manure, trade waste)
- Water soluble inorganic compounds (acids, salts, toxic metals and their compounds, anions e.g. sulphides, sulphites, and cyanide)
- Insoluble and soluble organic chemicals (oil, petrol, plastics, pesticides, solvents, PCBs, phenols, formaldehyde and others)
- Suspended solids (particles that are either insoluble or too large to be quickly dissolved)

The prevention of water pollution control in the Study Area is minimal, especially in the slum areas. Water is usually untreated at the pollution source and is then simply discharged into the various available water courses such as the Tongi River, swampy areas, etc. where it is then used by the lower income people without regard for health risk. The water pollution of the two rivers in the Dhaka area (BBS, 1996) is as follows: major

Table 5.6.1 Water Quality of Dhaka's Main Rivers

River	pH (-)	EC (μS/cm)	Chloride (mg/l)	TS (mg/l)	DO (mg/l)	BOD (mg/l)
Buriganga	6.9-7.5	142-404	2.5-24.1	174-331	3.6-6.5	1.0-13.0
Shitalakhya	7.0-7.3	109-380	7.0-22.5	145-257	6.0-7.0	1.6-2.4

Note: BOD at 20° C and 5 days